SUBCOURSE
AV0662

EDITION
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U S ARMY AVIATION CENTER

AVIATION SURVIVAL
PART II - PROTECTION FROM THE ENVIRONMENT

THIS SUBCOURSE HAS BEEN REVIEWED FOR
OPERATIONS SECURITY CONSIDERATIONS

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT
ARMY CORRESPONDENCE COURSE PROGRAM

AIPD

READINESS/PROFESSIONALISM THRU GROWTH

AVIATION SUBCOURSE 0662

AVIATION SURVIVAL

PART II. PROTECTION FROM THE ENVIRONMENT

3 Credit Hours

UNITED STATES ARMY AVIATION CENTER
FORT RUCKER, ALABAMA

AVIATION SUBCOURSE 0662

AVIATION SURVIVAL

PART II. PROTECTION FROM THE ENVIRONMENT

CONTENTS

INSTRUCTIONS TO STUDENTS

ATTENTION

This subcourse is the second part of a four-part series. Part I, Survival Elements, Psychological Aspects, and Survival Medicine, (AV 0661), must be taken before attempting Parts II, Protection From the Environment (AV 0662); III, Sustenance (AV 0663); and IV, Direction Finding, Signaling, and Recovery (AV 0664). Take Parts II through IV in any sequence.

This subcourse consists of one lesson, a review exercise and review exercise solutions, and an examination. A student inquiry sheet and a student survey sheet, which can be folded into preaddressed envelopes, are provided. We urge you to use them if you have a comment or question about the subcourse.

After you have studied the lesson, solve the review exercise and then compare your answers with those on the solutions page. Reread the lesson for any portion you miss.

When you have studied the entire subcourse, solved the review exercise, and checked your answers against the review exercise solutions, you will be ready to take the examination. You may use the lesson text and references when solving the examination. Follow the specific instructions that precede the examination.

This subcourse, at time of printing, conforms as closely as possible to US Army Aviation Center and Department of the Army doctrine. Therefore, you should base your solutions on the subcourse text and not on unit or individual experience.

Unless otherwise stated, whenever the masculine gender is used, both men and women are included.

INTRODUCTION

The information in this subcourse covers the materials used and the need for clothing in various survival situations. It also describes how the environment influences shelter site selection and the factors that survivors must consider before constructing an adequate shelter. A shelter is anything that protects a survivor from environmental hazards. Also covered are techniques and procedures for constructing shelters for various types of protection and firecraft. This knowledge will increase your chances of surviving after a crash or forced landing or being captured by the enemy.

Supplementary training material to be provided--none.

Material to be provided by the student--none.

Material to be provided by the unit or supervisor--none.

Supervision required--none.

Three credit hours are awarded for successful completion of this subcourse. Successful completion requires that you answer correctly at least 11 of 14 examination questions.

LESSON

TASKS:	9103.01-0001, Apply Techniques to Live Off the Land; 9103.01-0002, Maintain Physical Capability to Survival; and 9103.01-0003, Adopt the Code of Conduct as a Behavior Guide for Survival.
OBJECTIVE:	You will be able to describe personal protection, such as clothing, shelter, and firecraft.
CONDITIONS:	You may use the lesson text and references to complete the review exercise.
STANDARD:	You should answer correctly at least 12 of 16 review exercise questions.
REFERENCES:	ARs 95-17 (May 84), 350-30 (Dec 85), and 525-90 (Nov 71, with changes 1 and 2); AFM 64-5 (Sep 85); FMs 1-302 (Sep 83, with change 1), 20-150 (Jul 73, with changes 1 through 5), 21-76 (Mar 86); and DOD Directive 1300.7 (Dec 84).

LESSON TEXT

1. GENERAL

a. Every time people go outside they probably neglect to think about one of the most important survival-oriented assets--clothing. People have worn clothing for protection since they first put on animal skins, feathers, or other coverings. Clothing is often taken for granted; people tend to neglect those things that should be the most familiar to them. In most parts of the world, people need clothing for protection from harsh climates. Clothing also provides protection from physical injuries caused by vegetation, terrain features, and animal life which may cause bites, stings, and cuts.

(1) In arctic climates, people wear clothing made of fur, wool, or closely woven fabrics to insulate themselves from the effects of cold. They also wear warm footwear.

(2) In dry climates, people wear clothing made of lightweight materials, such as cotton or linen, that have an open weave. These materials absorb perspiration and allow air to circulate around the body. People in dry climates sometimes wear white or light-colored clothes to reflect the sun's rays. They may also wear sandals which are cooler and

more comfortable than shoes. To protect the head and neck, people wear hats as sunshades.

b. Clothing may be the survivor's only immediate form of protection from the environment. This is especially true during the first stages of survival episodes in cold climates. If survivors are not properly clothed, they may not survive long enough to build a shelter or fire.

c. The need for a fire should be placed high on the list of priorities. Fire is used for warming, lighting, drying clothes, signaling, making tools, cooking, and purifying water. When using fire for warmth, the body uses less calories for heat and consequently requires less food. Just having a fire to sit by is a morale booster. Smoke from a fire can be used to discourage insects.

d. Avoid building a very large fire. Small fires require less fuel, are easier to control, and their heat can be concentrated. Never leave a fire unattended unless it is banked or contained. You can bank a fire by scraping cold ashes and dry earth onto the fire. This leaves enough air coming through the dirt at the top to keep the fuel smoldering, keep the fire safe, and allow the fire to be rekindled from the saved coals.

Section I. CLOTHING

2. MATERIALS

Clothing is made from a variety of materials, such as nylon, wool, and cotton. The type of material used has a significant effect on the protection provided. Potential survivors must be aware of the environmental conditions and the effectiveness of these different materials in order to select the best type of clothing for a particular region. Clothing materials include many natural and synthetic fibers. As material is woven together, a dead-air space is created between the material fibers. When two or three layers of material are worn, a layer of air is trapped between each layer creating another layer of dead air or insulation. The ability of these different fibers to hold dead air is responsible for differing insulation values.

a. Natural Materials.

(1) Natural materials include fur, leather, and cloth made from plant and animal fibers. Fur and leather are made into some of the warmest and most durable clothing. Fur is used mainly for coats and coat linings. Leather has to be treated to make it soft and flexible and to prevent it from rotting.

(2) Cotton is a common plant fiber widely used to manufacture clothing. It absorbs moisture quickly and, with heat radiated from the body, allows the moisture to pass away from the body. It does not offer much insulation when wet. Cotton is used as an inner layer against the

skin and as an outer layer with insulation (wool, Dacron pile, or synthetic batting) sandwiched between. The cotton protects the insulation and, therefore, provides warmth.

(3) Wool is somewhat different because it contains natural lanolin oils. Although wool is somewhat absorbent, it retains most of its insulating qualities when wet.

b. Synthetic Materials. Clothing manufacturers are using more and more of these materials. Many synthetic materials are stronger, more shrink-resistant, and less expensive than natural materials. Most synthetic fibers are derived from petroleum in the form of long fibers that consist of different lengths, diameters, and strengths and sometimes have hollow cores. These fibers, woven into materials (nylon, Dacron, and polyester) make very strong long-lasting tarps, tents, clothing, and so forth. Some fibers are put into a batting type material with air space between the fibers. This provides excellent insulation when used inside clothing.

(1) Many fabrics are blends of natural and synthetic fibers. Fabrics could be a mixture of cotton and polyester or wool and nylon. Nylon covered with rubber is durable and waterproof but is also heavy. There are other coverings on nylon which are waterproof but somewhat lighter and less durable. However, most coated nylon has one drawback--it does not allow for perspiration evaporation. Therefore, individuals may have to change the design of the garment to permit adequate ventilation; for instance, wearing the garment partially unzipped.

(2) Synthetic fibers are generally lighter in weight than most natural materials and have much the same insulating qualities. They work well when partially wet and dry out easily; however, they generally do not compress as well as down.

3. INSULATION

a. Natural.

(1) Down is the soft plumage found between the skin and the contour feathers of birds. Ducks and geese are good sources for down. When used as insulation in clothing, remember that down readily absorbs moisture (either precipitation or perspiration). Because down is lightweight and compressible, it has wide application in cold-weather clothing and equipment. It is one of the warmest natural materials available when kept clean and dry. It provides excellent protection in cold environments; however if the down gets wet, it tends to get lumpy and loses its insulating value.

(2) With the exception of the forested regions of the far north, cattail plants are found worldwide. The cattail is a marshland plant found along lakes, ponds, and river backwaters. The fuzz on the tops of

the stalks forms dead-air spaces and makes a good down-like insulation when placed between two pieces of material.

(3) Leaves from deciduous trees (those that lose their leaves each autumn) also make good insulation. To create dead-air space, place leaves between two layers of material. Grasses, mosses, and other natural materials can also be used as insulation when placed between two pieces of material.

b. Synthetic.

(1) Synthetic filaments, such as polyesters and acrylics, absorb very little water and dry quickly. Spun synthetic filament is lighter than an equal thickness of wool and, unlike down, does not collapse when wet. It is also an excellent replacement for down in clothing.

(2) The nylon material in a parachute insulates well if used in layers because of the dead-air space created. However, survivors must use caution when using the parachute in cold climates. Nylon may become "cold soaked;" that is, the nylon takes on the temperature of the surrounding air. People have been known to receive frostbite when placing cold nylon against bare skin.

c. Measurement. The next area to be considered is how well these fibers insulate from the heat or cold. The most scientific way to consider the insulating value of these fibers is to use an established criterion. The commonly accepted measurement used is a comfort level of clothing called a "CLo" factor. The CLo factor is defined as the amount of insulation that maintains normal skin temperature when the outside ambient air temperature is 70 degrees Fahrenheit (°F) with a light breeze. However, the CLo factor alone is not sufficient to determine the amount of clothing required. Variables such as metabolic rate, wind conditions, and the physical makeup of the individual must be considered.

(1) The body's rate of burning or metabolizing food to produce heat varies among individuals. Therefore, some may need more insulation than others even though food intake is equal. Consequently, the required CLo value must be increased. Physical activity also causes an increase in the metabolic rate and the rate of blood circulation through the body. When a person is physically active, less clothing or insulation is needed than when standing still or sitting. The effect of the wind, as shown on the windchill chart (Table 1), must be considered. When the combination of temperature and wind drops the chill factor to minus 100°F or lower, the prescribed CLo for protecting the body may be inapplicable (over a long period of time) without relief from the wind.

EXAMPLE: When the temperature is minus 60°F, the wind is blowing 60 to 70 miles per hour, and the resultant chill factor exceeds minus 150°F, clothing alone is inadequate to sustain life. Shelter is essential.

(2) A person's physical build also affects the amount of heat and cold that can be endured. A very thin person will not be able to endure as low a temperature as one who has a layer of fat below the skin. Conversely, a heavy person will not be able to endure extreme heat as effectively as a thin person.

Table 1. Windchill chart.

WIND SPEED		COOLING POWER OF WIND EXPRESSED AS "EQUIVALENT CHILL TEMPERATURE"																				
KNOTS	MPH	TEMPERATURE (°F)																				
Calm	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
		EQUIVALENT CHILL TEMPERATURE																				
3 - 6	5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-65	-70
7 - 10	10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
11 - 15	15	25	15	10	0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
16 - 19	20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
20 - 23	25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
24 - 28	30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-95	-100	-110	-115	-125	-130	-140
29 - 32	35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
33 - 36	40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150
WINDS ABOVE 40 HAVE LITTLE ADDITIONAL EFFECT.		LITTLE DANGER					INCREASING DANGER (Flesh may freeze within 1 min)						GREAT DANGER (Flesh may freeze within 30 seconds)									
		DANGER OF FREEZING EXPOSED FLESH FOR PROPERLY CLOTHED PERSONS																				

INSTRUCTIONS

MEASURE LOCAL TEMPERATURE AND WIND SPEED IF POSSIBLE; IF NOT, ESTIMATE. ENTER TABLE AT CLOSEST 5°F INTERVAL ALONG THE TOP AND WITH APPROPRIATE WIND SPEED ALONG LEFT SIDE. INTERSECTION GIVES APPROXIMATE EQUIVALENT CHILL TEMPERATURE. THAT IS, THE TEMPERATURE THAT WOULD CAUSE THE SAME RATE OF COOLING UNDER CALM CONDITIONS.

NOTES

WIND

1. THIS TABLE WAS CONSTRUCTED USING MILES PER HOUR (MPH). HOWEVER, A SCALE GIVING THE EQUIVALENT RANGE IN KNOTS HAS BEEN INCLUDED ON THE CHART TO FACILITATE ITS USE WITH EITHER UNIT.
2. WIND MAY BE CALM BUT FREEZING DANGER GREAT IF PERSON IS EXPOSED IN MOVING VEHICLE, UNDER HELICOPTER ROTORS, IN PROPELLOR BLAST, ETC. IT IS THE RATE OF RELATIVE AIR MOVEMENTS THAT COUNTS AND THE COOLING EFFECT IS THE SAME WHETHER YOU ARE MOVING THROUGH THE AIR OR IT IS BLOWING PAST YOU.
3. EFFECT OF WIND WILL BE LESS IF PERSON HAS EVEN SLIGHT PROTECTION FOR EXPOSED PARTS. LIGHT GLOVES ON HANDS, PARKA HOOD SHIELDING FACE, ETC.

ACTIVITY DANGER IS LESS IF SUBJECT IS ACTIVE. A PERSON PRODUCES ABOUT 100 WATTS (341 BTUs) OF HEAT STANDING STILL BUT UP TO 1000 WATTS (3413 BTUs) IN VIGOROUS ACTIVITY LIKE CROSS-COUNTRY SKIING.

PROPER USE OF CLOTHING AND ADEQUATE DIET ARE BOTH IMPORTANT.

COMMON SENSE THERE IS NO SUBSTITUTE FOR IT. THE TABLE SERVES ONLY AS A GUIDE TO THE COOLING EFFECT OF THE WIND ON BARE FLESH WHEN THE PERSON IS FIRST EXPOSED. GENERAL BODY COOLING AND MANY OTHER FACTORS AFFECT THE RISK OF FREEZING INJURY.

(3) In the Army clothing inventory, there are many items that fulfill the need for insulating the body. They are made of the different fibers previously mentioned and, when worn in layers, provide varying degrees of insulative CLo value. The average zone temperature chart (Table 2) is a guide in determining the best combination of clothing to wear. The amount of CLo value per layer of fabric is determined by the loft (distance between the inner and outer surfaces) and the amount of dead air held within the fabric. Some examples of clothing and their respective CLo factors are shown in Table 3. This total amount of insulation should keep the average person warm at a low temperature. When comparing the Aramid underwear in Table 3, it shows when doubling the layers, the CLo value more than doubles. This is true between all layers of any clothing system. Therefore, you gain added protection by using several very thin layers of insulation rather than two thick layers. The air held between these thin layers increases the insulation value.

Table 2. Average temperature zone chart.

TEMPERATURE RANGE	CLo REQUIRED
86 to 68°F	1.0 (lightweight)
68 to 50°F	2.0 (intermediate weight)
50 to 32°F	3.0 (intermediate weight)
32 to 14°F	3.5 (heavyweight)
14 to -4°F	4.0 (heavyweight)
-4 to -40°F	4.0 (heavyweight)

Table 3. CLo factors for some items of clothing.

LAYERS	ITEM	CLo FACTOR
1	Aramid underwear	0.6
2	Aramid underwear	1.5
3	Quilted liners	1.9
4	Nomex coveralls	.6
5	Winter coveralls	1.2
6	Nomex jacket	1.9

(4) Using many thin layers also provides (through removal of desired number of layers) the ability to closely regulate the amount of heat retained inside the clothing. The ability to regulate body

temperature helps alleviate the problem of overheating and sweating and preserves the effectiveness of the insulation.

(5) The principle of using many thin layers of clothing can also be applied to the "sleeping system" (sleeping bag, liner, and bed). This system uses many layers of synthetic material, one inside the other, to form the amount of dead air needed to keep warm. To improve this system, wear clean, dry clothing in layers (the layer system) in cold climates. While discussing the layer system, it is important to define the "COLDER" principle (Figure 1). This acronym is used to aid in remembering how to use and take care of clothing.

C--CLEAN (Keep clothing clean.)
O--OVERHEATING (Avoid overheating.)
L--LOOSE (Wear clothing loose and in layers.)
D--DRY (Keep clothing dry.)
E--EXAMINE (Examine clothing for defects or wear.)
R--REPAIR (Keep clothing repaired.)

Figure 1. The COLDER principle.

(a) Clean. Dirt and other materials inside fabrics cause the insulation to be ineffective, abrade and cut the fibers that make up the fabric, and cause holes. Washing clothing in the field may be impractical; therefore, concentrate on using proper techniques to prevent soiling clothing.

(b) Overheating. Clothing best serves the purpose of preserving bodyheat when worn in layers as follows: absorbent material next to the body, insulating layers, and outer garments to protect against wind and rain. Because of the rapid change in wind, temperature, and physical exertion, garments should allow quick and easy donning and removal. Ventilation is essential when working. When you enclose the body in an airtight layer system, this results in perspiration which wets clothing and reduces its insulating qualities.

(c) Loose. Garments should be loose fitting to avoid reducing blood circulation and restricting body movement. Additionally, the garment should overhang the waist, wrists, neck, and ankles to reduce body heat loss.

(d) Dry. Keep clothing dry; a small amount of moisture in the insulation fibers causes heat loss up to 25 times faster than dry clothing. Internally produced moisture is as damaging as is externally dampened clothing. The outer layer should protect the inner layers from moisture as well as from fiber abrasion, such as wool rubbing on logs or rocks. This outer shell keeps dirt and other contaminants out of the clothing. Clothing can be dried in many ways. Fires are often used; however, take care to avoid burning the items. The "bare hand" test is very effective. Place one hand near the fire in the approximate place the wet items will be and count slowly to three. If this can be done without feeling excessive heat, it should be safe to dry items there. Never leave any item unattended while it is drying. Leather boots, gloves, and mitten shells require extreme care to prevent shrinking, stiffening, and cracking. The best way to dry boots is upright beside the fire or simply walk them dry in milder climates. When boots are dried upside down on sticks, the moisture does not escape the boot. Sun and wind can be used to dry clothing with little supervision except for checking occasionally on incoming weather and ensuring the article is secure. Freeze-drying is used in subzero temperatures with great success. Let water freeze on or inside the item and then shake, bend, or beat it to cause the ice particles to fall free from the material. Tightly woven fibers work better with this method than do open fibers.

(e) Examine and Repair. All clothing items should be inspected regularly for signs of damage or soil. Eskimos set an excellent example in the meticulous care they provide for their clothing. When damage is detected, immediately repair it.

(6) The head, neck, hands, armpits, groin, and feet lose more heat than other parts of the body and require greater protection. Work with infrared film shows tremendous heat loss in those areas when not properly clothed. Survivors in a cold environment are in a real emergency situation without proper clothing.

(7) Models wearing samples of aircrew attire appear as spectral figures in a thermogram, an image revealing differences in infrared heat radiated from their clothing and exposed skin. White is warmest; red, yellow, green, blue, and magenta form a declining temperature scale spanning about 15 degrees; black represents all lower temperatures. Almost the entire scale is seen on a model in boxer shorts. Warm, white spots appear on the underarm and neck. The shorts block radiation from the groin. Temperatures cool along the arm to dark blue fingertips far from the heat-producing torso. The addition of the next layer of clothing (Aramid long underwear) prevents heat loss except where it is tight against the body. As more layers are added, it is easy to see the areas of greatest concern are the head, hands, and feet. These areas are difficult for crew members to properly insulate while flying an aircraft. Mittens are ineffective because of degraded manual dexterity. Likewise, it is difficult to feel the rubber pedal action while wearing bulky warm boots. These problems require inclusion of warm hats, mittens, and footgear (mukluk type) in survival kits during cold weather operation. Research has shown that when 10 CLo is used to insulate the head, hands, and feet and the rest of the body is only protected by 1 CLo, the average individual can be exposed to low temperatures (-10°F) comfortably for a reasonable period of time (30 to 40 minutes). When the amount of CLo value placed on the individual is reversed, the amount of time a survivor can spend in cold weather is greatly reduced because of heat loss from his

extremities. This same principle works in reverse in hot climates. If a person submerges the head, hands, or feet in cold water, it lets the most vascular parts of the body lose heat quickly.

4. HOT CLIMATES

In the hot climates of the world, clothing is needed to protect against heat, sand, sunburn, and insects. Do not discard any clothing. Keep your head and body covered and blouse the legs of pants over the tops of footwear during the day. Do not roll up sleeves, but keep them rolled down and loose at the cuff to stay cool.

a. Tropical.

(1) When moving through vegetation, roll down your sleeves, wear gloves, and blouse the legs of pants or tie them over boot tops. Improvised puttees (gaiters), made from any available fabric, protect legs from ticks and leeches. Loosely worn clothing keeps you cooler especially when subjected to the direct rays of the sun. Wear a head net or tie material around the head for protection against insects. The most active time for insects is at dawn and dusk. Use insect repellent at these times.

(2) In open country or in high grass, wear a neck cloth or improvised head covering to protect from sunburn or dust. Also move carefully through tall grass, as some sharp-edged grasses can cut clothing to shreds. Dry clothing before nightfall. If an extra change of clothing is available, make an effort to keep it clean and dry.

b. Desert.

(1) Keep in mind that the people who live in the hot dry areas of the world usually wear heavy white flowing robes that protect almost every inch of their bodies. The only areas open to the sun are the face and eyes. White clothing reflects the sunlight and produces an area of higher humidity between the body and the clothing. This helps keep them cooler and conserves their perspiration (Figure 2).

(2) You should wear a cloth neckpiece to cover the back of the neck and protect it from the sun. A T-shirt makes an excellent neck drape using the extra material as padding under the cap. If hats are not available, make headpieces like those worn by the Arabs (Figure 2). During duststorms, wear a covering for the mouth and nose; any fabric material will work.

5. ARCTIC CLIMATES

a. Winter. Blood distributes the body heat and helps prevent frostbite; therefore, clothing should not be worn so tight that it restricts blood flow. Release any restriction caused by twisted clothing or a tight parachute harness. Since clothing should be kept as dry as possible, snow must be brushed from clothing before entering a shelter or going near a fire. Beat the frost out of your garments before warming them, and then dry them on a rack near a fire. Thoroughly dry socks.

(1) When exerting the body, prevent perspiration by opening clothing at the neck and wrists and loosening it at the waist. If the body is still warm, take off outer layers of clothing, one layer at a time, for comfort. When work stops, put the clothing on again to prevent chilling.

(2) In strong wind or extreme cold, as a last resort, wrap up in whatever fabric is available, and get into some type of shelter or behind a windbreak. Take extreme care with hard materials, such as synthetics, as they may become cold soaked and require more time to warm.

(3) Keep the head and ears covered. You will lose as much as 50 percent of your total body heat from an unprotected head at 500F. To help prevent sun or snow blindness, wear sun or snow goggles or improvise a shield with a small horizontal slit opening (Figure 3).

(4) One or two pairs of wool gloves, mittens, or both should be worn inside a waterproof shell (Figure 4). When wearing more than one pair of gloves, ensure that each succeeding pair is large enough to fit comfortably over the other. If you have to expose your hands, warm them inside your clothing.

(5) All clothing made of wool offers good protection when used as an inner layer. When wool is used next to the face and neck, remember that moisture from the breath condenses on the surface and

Figure 2. Protective desert clothing.

causes the insulating value to decrease. Using a wool scarf wrapped around the mouth and nose is an excellent way to prevent cold injury, but it needs to be deiced on a regular basis to prevent freezing the flesh adjacent to it. An extra shell is generally worn over the warming layers to protect them and to act as a windbreak.

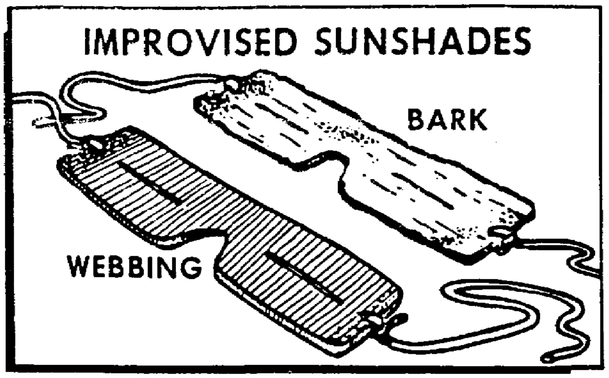

Figure 3. Improvised goggles.

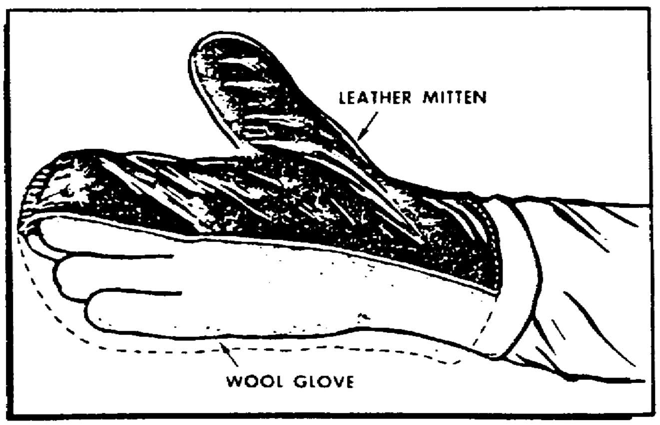

Figure 4. Layer system for hands.

(6) Other headgear includes the pile cap and hood. These items are most effective in extreme cold when used with a covering for the face. The pile cap is extremely warm where it is insulated, but it offers little protection for the face and back of the neck. The hood is designed to funnel the radiant heat rising from the rest of the body and to recycle it to keep the neck, head, and face warm (Figure 5). Your ability to tolerate cold should dictate the size of the front opening of the hood. The "tunnel" of a parka hood is usually lined with fur of some kind to act as a protecting device for the face. This same fur also helps protect the hood from the moisture expelled during breathing. The closed tunnel holds heat close to the face longer; the open tunnel allows the heat to escape more

freely. As the frost settles on the hair of the fur, shake it from time to time to keep it free of ice buildup.

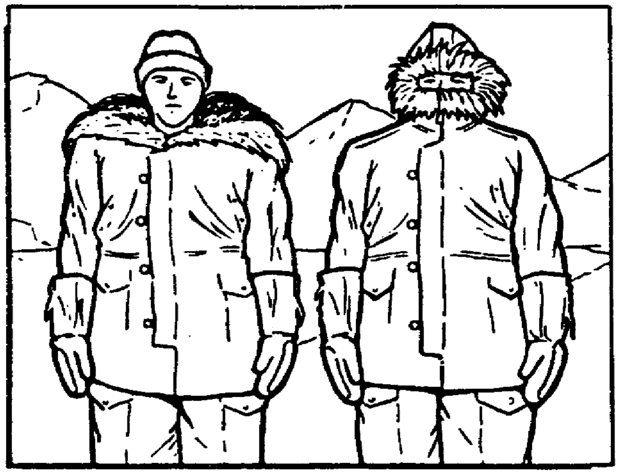

Figure 5. Proper wear of parka.

(7) If you fall into water, first roll in dry snow to blot up the moisture. Next, brush off the snow and roll again until most of the water is absorbed. Do not remove footwear until you are in a shelter or beside a fire.

(8) Sleeping systems (sleeping bag, liner, and bed) are the transition "clothing" used between normal daytime activities and sleep (Figure 6). At night, arrange dry spare clothing loosely around and under the shoulders and hips to help keep the body warm. Wet clothes should never be worn into the sleeping bag. The moisture destroys the insulation value of the bag. The insulating material in the sleeping bag may be synthetic or down and feathers. (Feathers and down lining require extra protection from moisture.) However, the covering is nylon. You must realize that sleeping bags are compressed when packed and must be fluffed before use to restore the insulation value. Clean and dry socks, mittens, and other clothing can be used to provide additional insulation.

b. <u>Summer</u>. In the summer arctic, there are clouds of mosquitoes and black flies so thick a person can scarcely see through them. You can protect yourself by wearing proper clothing to ensure no bare skin is exposed. Remember that mosquitoes do not often bite through two layers of cloth; therefore, a lightweight undershirt and long underwear help. To protect ankles, blouse the bottoms of trousers around boots or wear some type of leggings (gaiters). To protect the face and hands, wear a good head net and gloves.

(1) Head nets must stand out from the face so they won't touch the skin. Issued head nets are either black or green. If one needs to be

improvised, it can be sewn to the brim of the hat or attached with an elastic band that fits around the crown.. Black is the best color, as it can be seen through more easily than green or white. Attach to the bottom of the head net a heavy tape encasing a drawstring for tying snugly at the collar. Hoops of wire fastened on the inside make the net stand out from the face and, at the same time, allow it to be packed flat. The larger they are, the better the ventilation. However, very large nets will not be as effective in wooded country where they may become snagged on brush. If the head net is lost or none is available, make the best of a bad situation by wearing sunglasses with improvised screened sides, plugging ears lightly with cotton, and taping a handkerchief around the neck. Treat clothing with insect repellent at night.

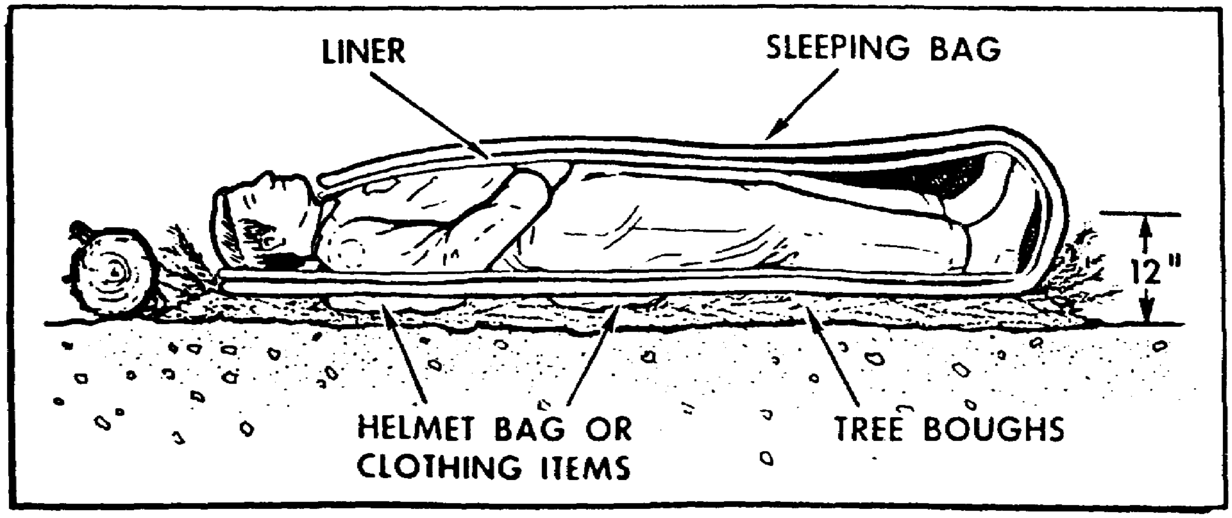

Figure 6. Sleeping system.

(2) Gloves are hot but are a necessity where flies are found in swamps. Kid gloves with a 6-inch gauntlet closing the gap at the wrist and ending with an elastic band halfway to the elbow are best. For fine work, kid gloves with the fingers cut off are good. Cotton or Nomex work gloves are better than no protection at all, but mosquitoes bite through them. Treating the gloves with insect repellent helps. Smoky clothing may also help to keep insects away (Figure 7).

6. AT SEA

a. <u>Cold Oceans</u>. In cold oceans, you must try to stay dry and keep warm. Clothes should be loose and comfortable. Put on any extra clothing available. If no anti-exposure suits are provided, drape extra clothing around your shoulders and over your heads. Attempt to keep the floor. of the raft dry. For insulation, covering the floor with any available material helps. Survivors should huddle together on the floor of the raft and spread extra sail, tarpaulin, or parachute material over the group. If in a 20- or 25-man raft, canopy sides can be lowered.

(1) If survivors are wet, give them the most sheltered positions in the raft. They should use a windscreen to decrease the cooling effects of the wind and should also remove, wring out, and replace outer garments or change into dry clothing. Dry hats, socks, and gloves. If any survivors are dry, they should share extra clothes with those who are wet. Wet personnel should warm their hands and feet against those who are dry.

(2) Performing mild exercises to restore circulation may be helpful. Exercise fingers, toes, shoulders, and buttock muscles. Mild exercise helps keep the body warm, stave off muscle spasms, and possibly prevent medical problems. Warm hands under armpits and periodically raise feet slightly and hold them up for a minute or two. Also move face muscles frequently to prevent frostbite. Shivering is the body's way of quickly generating heat and is considered normal. However, persistent shivering may lead to uncontrollable muscle spasms that can be avoided by exercising the muscles.

(3) If potable water is available, give additional rations to those suffering from exposure to cold. Eat small amounts frequently rather than one large meal.

b. <u>Warm Oceans</u>. Protecting the body against the sun and obtaining and securing drinking water are most important when surviving in warm oceans. Keep the body covered completely. Sun exposure increases thirst, wastes precious water, reduces the body's water content, and causes serious burns. Roll dawn your sleeves, pull up your socks, close your collars, wear a hat or improvised headgear, use a piece of cloth as a

Figure 7. Insect protection.

shield for the back of the neck, and wear sunglasses or improvise eye covers. Keep the body covered as much as possible to avoid sunburn. Improvise a sunshade out of any material available or use the canopy provided with the raft. If the heat becomes too intense, dampen clothing with sea water to promote evaporation and cooling. Using sunburn preventive cream or a Chapstick is advisable.

c. Antiexposure Garments.

(1) Assemblies. The antiexposure assemblies, quick donning and constant wear, are designed for personnel participating in overwater flights where unprotected or prolonged exposure to cold air, water (as a result of ditching or abandoning an aircraft), or both would be dangerous or could prove fatal. The suit protects from the wind and insulates against the chill of the ocean. The result of exposure in the water is illustrated in Figures 8 and 9. Exposure time varies depending on the particular antiexposure assembly worn, the cold sensitiveness of the person, and survival procedures used.

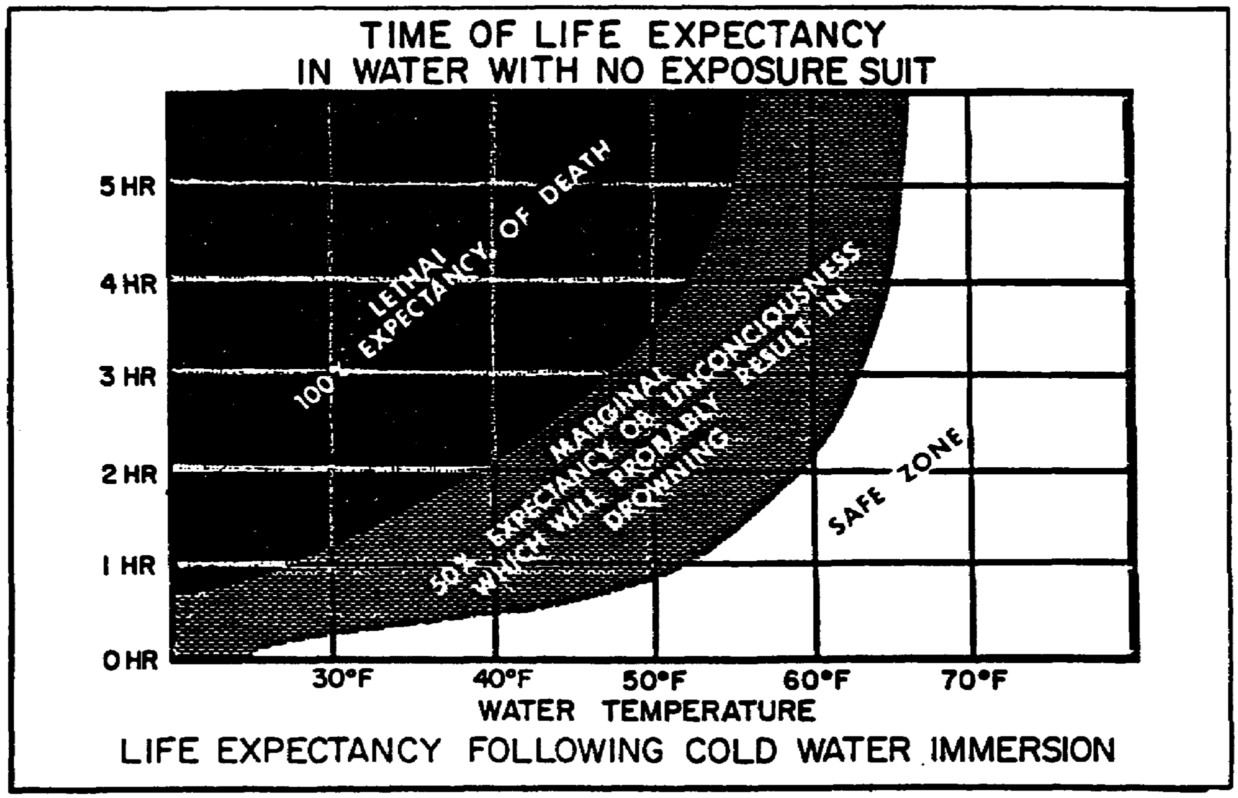

Figure 8. Life expectancy following cold-water immersion.

(2) Quick-Donning Antiexposure Flight Coverall. Some antiexposure coveralls are designed for quick donning (approximately one

minute) before emergency ditching. After ditching the aircraft, the coverall protects the wearer from exposure while swimming in cold water and from exposure to wind, spray, and rain when adrift in a liferaft.

(a) The coverall is one size made from chloroprene-coated nylon cloth. It has two expandable patch pockets, an adjustable waist belt, and attached boots with adjustable ankle straps. Also provided is one pair of insulated, adjustable wrist snap mittens, each with a strap attached to a pocket. A hood, attached with a strap, is in the left pocket. A carrying case with instructions and a snap fastener closure is furnished for stowing in the aircraft.

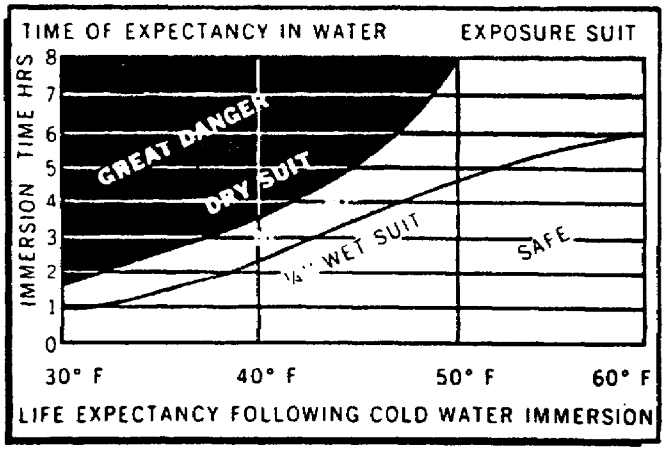

Figure 9. Life expectancy following cold-water immersion (exposure suit).

(b) Personnel should wear the coverall over regular flight clothing. It is large enough to wear over the usual flight gear. The gloves and hood are stowed in the pockets of the coverall and are normally worn after boarding the liferaft.

(c) Be extremely careful when donning the coverall to prevent damage by snagging, tearing, or puncturing it on projecting objects. After donning the coverall, adjust the waistband and boot ankle straps to take up fullness. If possible, stoop while pulling the neck seal to expel air trapped in the suit. When jumping into the water, leap feet first with hands and arms close to your sides or brought together above your head (Figure 10).

NOTE: There is a constant wear exposure suit designed to be worn continuously during overwater flights where the water temperature is 60°F or below.

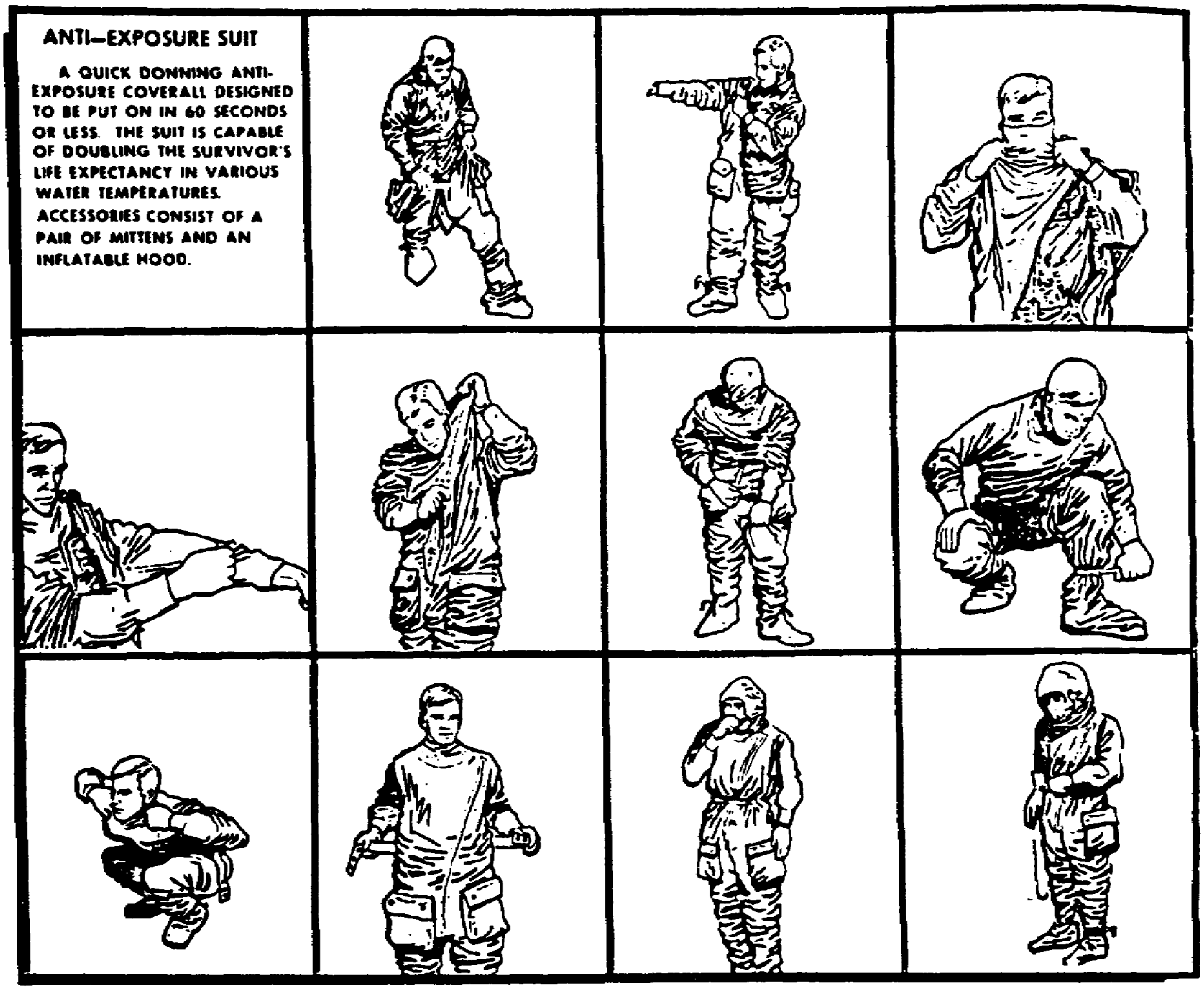

Figure 10. Donning the antiexposure suit.

7. FOOTGEAR

Footgear is critical in a survival situation because walking is the only means of mobility. Therefore, care of footgear is essential before and during a survival situation. Recommendations for care include ensuring footgear is properly broken-in before flying and keeping leather boots as dry as possible. Be sure to treat footgear to ensure water-repellence (follow manufacturer's recommendations). When wearing more than one pair of socks, ensure that each succeeding pair is large enough to fit comfortably over the other. Don't wear three or four pairs of socks in a shoe fitted for only one or two pairs.

a. <u>Grass Insoles</u>. Northern natives used grass extensively to construct inner soles. Grass is a good insulator and collects moisture from the feet. To prepare grass for use as inner soles, grasp a one-half inch diameter sheaf of tall grass with both hands and rotate the hands in opposite directions. The grass breaks up or "fluffs" into a soft mass.

Form this fluff into oblong shapes and spread it evenly throughout the shoes about an inch thick. Remove these inner soles at night and make new ones the following day.

b. Double Socks. The essence of this technique is to place cushion padding, feathers, dry grass, or any other insulation material between layers of socks. Durable fabric, such as parachute material or canvas, is then wrapped around the foot and tied above the ankle. A combination of two or more types of improvised footwear may be more desirable and more efficient than any single type (Figure 11).

Figure 11. Double socks.

c. Gaiters. Gaiters are made from cloth, webbing, or canvas. They help keep sand and snow out of shoes and protect the legs from bites and scratches (Figure 12).

d. Russian Socks. If shoes are lost or if they wear out, survivors can improvise footgear. One example of this is the Russian Sock. Parachute material can be used to improvise these socks. Cut material into strips approximately 2 feet long and 4 inches wide. Wrap these strips in bandage fashion around the feet and ankles. Socks made this way provide comfort and protection for the feet.

Figure 12. Gaiters.

e. Hudson Bay Duffel. A triangular piece of material used as a foot covering is known as the Hudson Bay duffel. To improvise this foot covering, cut two to four layers of cloth into 30-inch squares. Fold the square to form a triangle. Place the foot on this triangle with the toes pointing at one corner. Fold the front cover up over the toes and the side corners, one at a time, over the instep to complete the foot wrap (Figure 13).

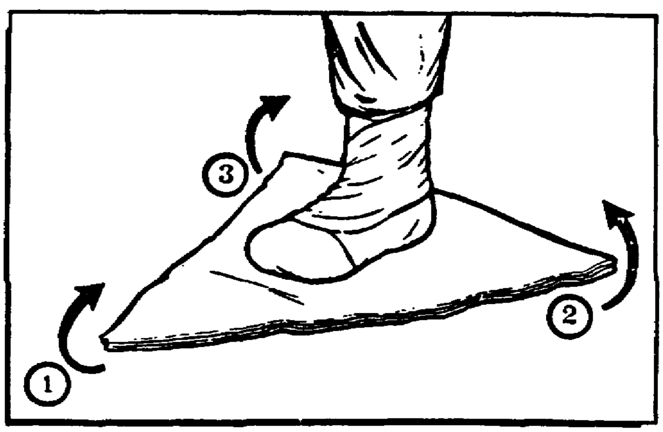

Figure 13. Hudson Bay duffel.

f. Boots.

(1) If boots are large enough, additional insulation material, such as dry grass or moss, can be placed between the feet and boots. An alternate to placing insulation material inside each boot is to wrap each foot with a durable piece of cloth material lined with insulation.

(2) Felt booties and mukluks with proper socks and insoles are best for dry, cold weather. Rubber-bottomed boot shoepacs with leather tops are best for wet weather. Vapor barrier rubber boots can be worn under both conditions and are best at extremely low temperatures. Close the air release valve at ground level. These valves are designed to release pressure when airborne. Air should not be blown into the valves as moisture could decrease insulation.

g. Mukluks have been around for thousands of years and have proven their worth in extremely cold weather. However, they should not be worn in wet weather. Army mukluks (Figure 14) are made of cotton duck with rubber-cleated soles and heels. They have slide fasteners from instep to collar, laces at the instep and collar, and are 18 inches high. Flight and ground personnel use them when operating under dry, cold conditions in temperatures below ± 15°F. Survivors should change liners daily when possible.

Figure 14. Issued mukluks.

h. Moose Hock Shoe. The hock skin of a moose or caribou provides a suitable pair of shoes as shown in Figure 15. Cut the skin around the leg at A and C. Separate the skin from the leg and pull it over the hoof. Shape and sew up the small end C. Slit the skin from A to B; bore holes on each side of the cut for lacing. Turn it inside out and lace it with rawhide, suspension line, or other suitable material.

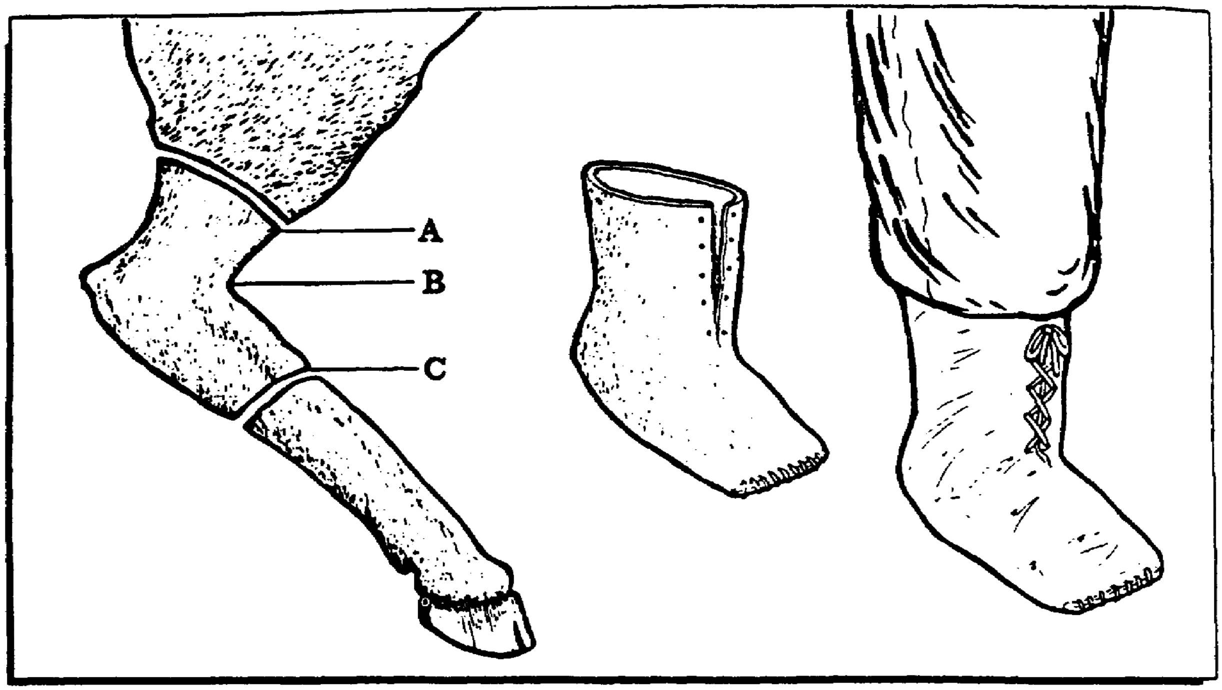

Figure 15. Moose hock shoes.

Section II. SHELTER

8. CONSIDERATIONS

Before setting up a shelter, consider the time of day, weather conditions, life forms, terrain, location, and type. Make every effort to use as little energy as possible and yet attain maximum protection from the environment. All of these factors vary with each survival situation.

a. Time of Day. Late afternoon is not the best time to look for a site that meets that day's shelter requirements. If you wait until the last minute, you may be forced to use poor materials in unfavorable conditions. Constantly think of ways to satisfy your needs to protect yourself from environmental hazards.

b. Weather. When selecting a shelter site, weather conditions are a key consideration. Failure to consider the weather could have disastrous results. Some major weather factors that can influence your choice of site selection and shelter type are wind, temperature, and precipitation.

(1) Wind. Wind can be either an advantage or a disadvantage depending on the area temperature and wind velocity. During the summer or on warm days, take advantage of the cool breezes and the protection the wind provides from insects by locating your camp on knolls or spits of land. Conversely, wind becomes annoying or even a hazard when blowing sand, dust, or snow causes skin and eye irritation and damage to clothing and equipment. On cold days or during winter months, seek shelter sites protected from the effects of windchill and drifting snow.

(2) Temperature. Temperatures can vary considerably within a given area. Situating a campsite in low areas, such as a valley, in cold regions can expose survivors to low night temperatures and windchill factors. Colder temperatures are found along valley floors sometimes referred to as "cold air sumps." It may be advantageous to situate campsights to take advantage of the sun. You could place your shelter in an open area during the colder months for added warmth and in a shaded area for protection from the sun during hotter weather. In some areas you may have to compromise. For instance, in many deserts daytime temperatures can be very high while at night low temperatures can turn water to ice. Protection from heat and cold are needed in these areas. Choose the shelter type and location that protects you from existing temperature conditions.

(3) Precipitation. Many forms of precipitation (rain, sleet, hail, or snow) can also present problems for survivors. Shelter sites should be out of major drainages and other low areas to provide protection from the flash floods or mud slides caused by heavy rains. Snow can also be a great danger if shelters are placed in potential avalanche areas.

c. Life Forms. Consider all life forms (plant, human, and animal) When selecting the campsite and shelter type that will be used. The human factor may mean the enemy or other groups from whom you wish to remain undetected. For a shelter to be adequate, especially if extended survival is expected, certain factors must be considered.

(1) Insect life can cause disease, injury, and personal discomfort. By locating shelters on knolls, ridges, or any other area that has a breeze or steady wind, you can reduce the number of flying insects in your area. Staying away from standing water sources helps avoid bees, wasps, hornets, and mosquitoes. Ants can be a major problem; some species vigorously defend their territories with painful stings, bites, or particularly distressing pungent odors.

(2) Large and small animals can also be a problem. This is especially true if the camp is situated near trails or waterholes.

(3) Avoid dead trees that are standing and trees with dead branches. Wind may cause them to fall causing injuries or death. Avoid poisonous plants, such as poison oak or poison ivy, when locating a shelter.

d. Terrain. Terrain hazards may not be as apparent as weather and animal life hazards, but they can be many times more dangerous. Avoid rock, avalanche, dry streambeds, or mud-slide areas. These areas can be recognized by either a clear path or a path of secondary vegetation, such as 1- to 15-foot-tall vegetation or other new growth that extends from the top to the bottom of a hill or mountain. Do NOT choose shelter sites at the bottom of steep slopes that may be prone to slides. Likewise, there is a danger in camping at the bottom of steep scree (loose stones) or talus (rock debris) slopes. Additionally, check rock overhangs for safety before using them as shelters.

e. Location. Four prerequisites must be satisfied when selecting a shelter location. First, you must be near food, fuel, water, and a signal or recovery site. Second, the area must be safe and provide natural protection from environmental hazards. Third, sufficient materials must be available to construct the shelter. In some cases, the shelter may already be present. Survivors seriously limit themselves if they assume shelters must be a fabricated framework having predetermined dimensions and a cover of parachute material or a signal paulin. More appropriately, survivors should consider using sheltered places already in existence in the immediate area. This does not rule out shelters with a fabricated framework and parachute or other manufactured material covering; it simply enlarges the scope of what can be used as a survival shelter. Finally, choose an area large enough and level enough for you to lie down. Personal comfort is an important fundamental to consider. An adequate shelter provides physical and mental well-being for sound rest. Adequate rest is extremely vital if you are to make sound decisions. Your need for rest becomes more critical as time passes and rescue or return is delayed. Before actually constructing a shelter, determine the specific purpose of the shelter. Factors influencing shelter type fabrication are listed in Figure 16.

Cold
Heat
Insects
Length of expected stay
Enemy presence in the area
Rain or other precipitation
Number and physical condition of survivors
Available materials nearby (manufactured or natural)

Figure 16. Factors influencing shelter construction.

(1) If possible, try to find a shelter that needs little work to be adequate. Using what is already there, so that complete construction of a shelter is not necessary, saves time and energy. Modifications may include adding snow blocks to finish off an existing tree well shelter,

increasing the insulation of the shelter by using vegetation or parachute material, or building a reflector fire in front of a rock overhang or cave. You must consider the amount of energy required to build the shelter. It is not really wise to spend a great deal of time and energy in constructing a shelter if nature has provided a natural shelter nearby that satisfies your needs. Some examples of naturally occurring shelters (Figure 17) include caves, snow banks, fallen logs, rock overhangs, large crevices, or root buttresses. All of these can be modified to provide adequate shelter.

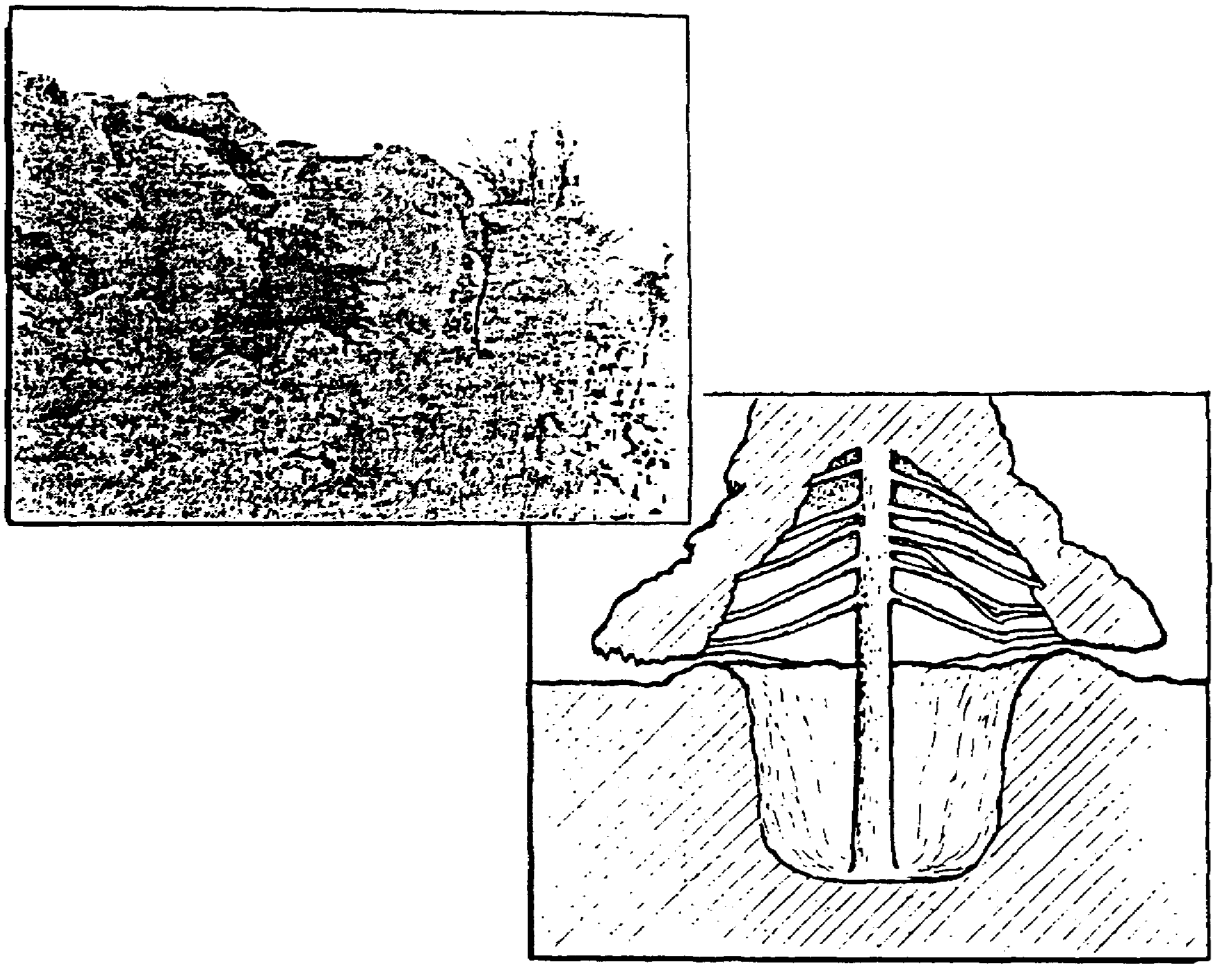

Figure 17. Natural shelters.

(2) The size limitations of a shelter are important only if there is a lack of material on hand or if it is cold. Otherwise, the shelter should be large enough to be comfortable yet not so large as to cause an excessive amount of work. Any shelter, natural or otherwise, in which a fire is to be built must have a ventilation system that provides fresh air and allows smoke and carbon monoxide to escape. Even if a fire does not produce visible smoke; such as heat tabs, the shelter still must

be vented. Figure 18 shows placement of ventilation holes in a snow cave. If a fire is to be placed outside the shelter, the opening of the shelter should be placed 90 degrees to the prevailing wind. This reduces the chances of sparks and smoke being blown into the shelter if the wind should reverse direction in the morning and evening. This frequently occurs in mountainous areas. The best fire-to-shelter distance is approximately 3 feet. One place where it would not be wise to build a fire is near the aircraft wreckage, especially if it is being used as a shelter. The possibility of igniting spilled lubricants or fuels is great. Survivors may decide instead to use materials from the aircraft to add to a shelter located a safe distance from the crash site.

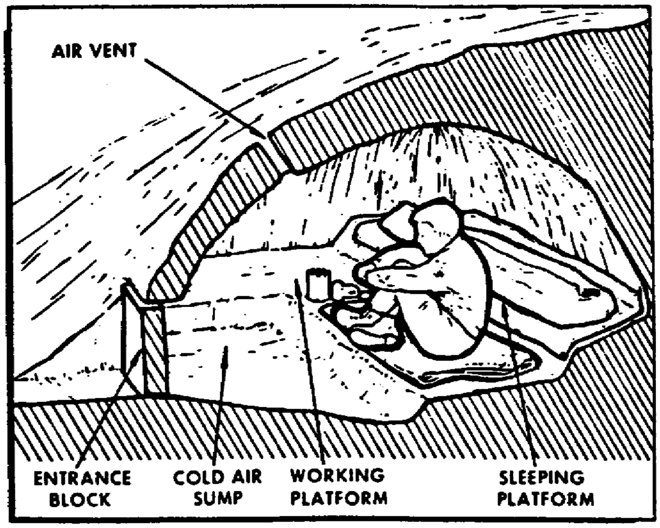

Figure 18. Snow cave shelter living.

f. Shelter Types.

(1) Immediate action.

(a) An immediate action shelter is one that can be erected quickly with minimum effort, such as a raft, aircraft parts, parachutes, a paulin, or a plastic bag. It is the first type of shelter that you may consider using or the first type you may be forged to use. Natural formations can also shield you immediately from the elements. These include caves, tree wells, fallen logs, and overhanging ledges (Figure 19). Remember that if shelter is needed, use an existing shelter if at all possible. Improvise on natural shelters or construct new shelters only if necessary. It isn't necessary to be concerned with exact shelter dimensions. Regardless of type, the shelter must provide whatever protection is needed and, with a little ingenuity, it should be possible for you to protect yourself and do so quickly.

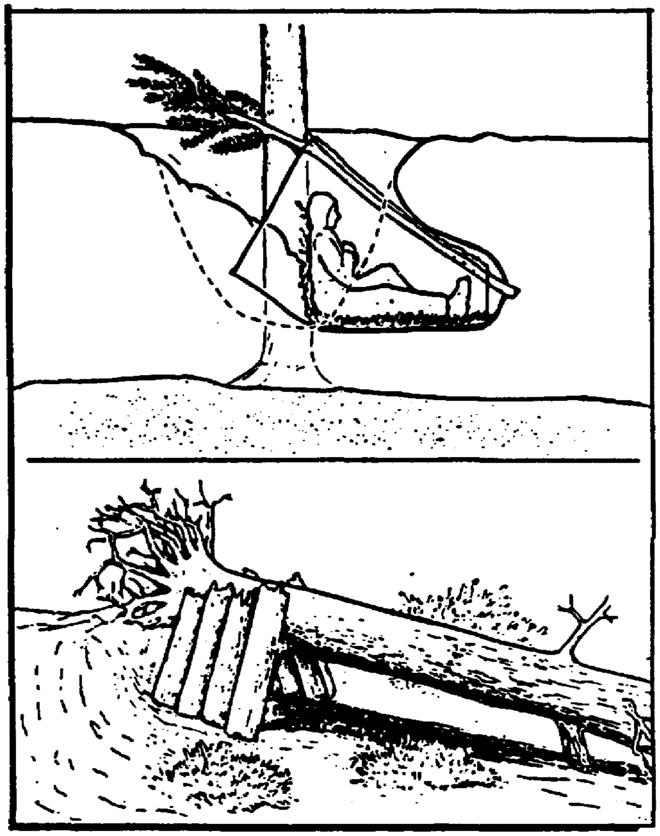

Figure 19. Immediate action shelters.

(b) In many instances, immediate action shelters may have to serve as permanent shelters for aircrew members. For instance, most aircrew members fly without parachutes, large cutting implements (axes), and entrenching tools; therefore, a multi-person life raft may be the only immediate or long-term shelter available. In this situation, deploy the multiperson liferaft in the quickest manner possible to ensure that maximum advantages are attained. Keep certain principles in mind. First, set up the shelter in an area that affords maximum protection from wind and precipitation. Use the basic shelter principles stated earlier in this paragraph. Next, anchor the raft for retention during high winds. Last, use additional boughs and grasses for ground insulation.

(2) Improvised. Shelters of this type should be easy to construct or dismantle in a short period of time. However, these shelters usually require more time to construct than immediate action shelters. For this reason, you should only consider this shelter type when you are not immediately concerned with getting out of the elements. These shelter types include the A-frame, simple shade shelter (useful in dry areas); various poncho shelters; snow and tree-pit shelters; sod shelters; and other variations.

9. CONSTRUCTION

a. A-frame. The A-frame design is adaptable to all environments and is easily modified (Figure 20). There are as many variations of this shelter as there are builders. Types include the tropical para-hammock, temperate area "A-frame," arctic thermal "A-frame," and fighter trench. One way to build an A-frame shelter in a warm temperature environment is to use fabric material for the covering. The procedures in Figure 21, if followed carefully, result in completing a safe shelter that meets your needs.

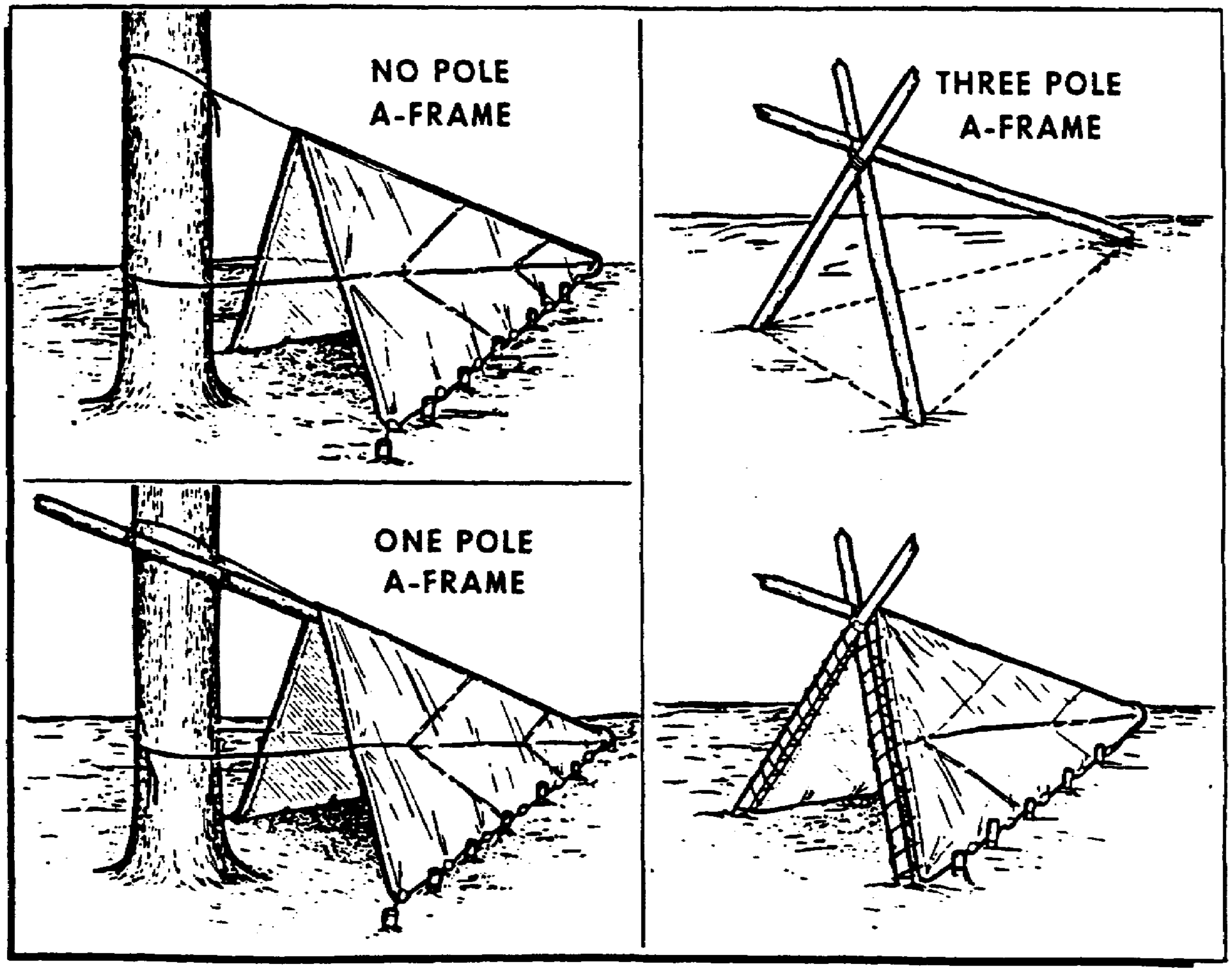

Figure 20. A-frame shelters.

b. Lean-To. The lean-to is a shelter type that is useful in protecting occupants from the effects of direct sunlight, moisture, and wind (Figure 22). Placement of the opening opposite to the prevailing wind is critical to the effectiveness of this shelter design. Figure 23 provides step-by-step instructions for constructing a lean-to.

MATERIALS NEEDED

One 12 to 18 foot sturdy ridge pole with all projections cleaned off
Two bipod poles, approximately 7 feet long
Fabric material
Lines
"Buttons" (small objects placed behind gathers of material to provide a secure way of affixing line to the material)
Approximately 14 stakes, about 10 inches long

PROCEDURE

STEP 1: Lash the two bipod poles together at eye-level.

STEP 2: Place the ridge pole, with the large end on the ground, into the bipod formed by the poles; secure with a square lash. The bipod structure should be 90 degrees to the ridge pole, and the bipod poles should be spread out to an approximate equilateral triangle of a 60-degree pitch. A piece of line can be used to measure this.

STEP 3: Tie off about 2 feet of the end of the fabric in a knot; tuck this under the butt end of the ridge pole. Use half hitches and clove hitches to secure the material to the base of the pole.

STEP 4: Place the center of the fabric on the ridge pole. After pulling the material taut, use half hitches and clove hitches to secure the fabric to the front of the ridge pole.

STEP 5: Scribe or draw a line on the ground from the butt of the ridge pole to each bipod pole. Stake the fabric down. Start at the rear of the shelter and alternately stake from side to side to the shelter front. Stakes should be slanted or inclined away from the direction of the pull. Use a sufficient number of stakes to ensure the material is wrinkle-free.

STEP 6: Tie off the line with a clove hitch. The line should pass in front of the stake first and then pass under itself to allow the button and line to be pulled 90 degrees to the wrinkle.

Figure 21. A-frame construction.

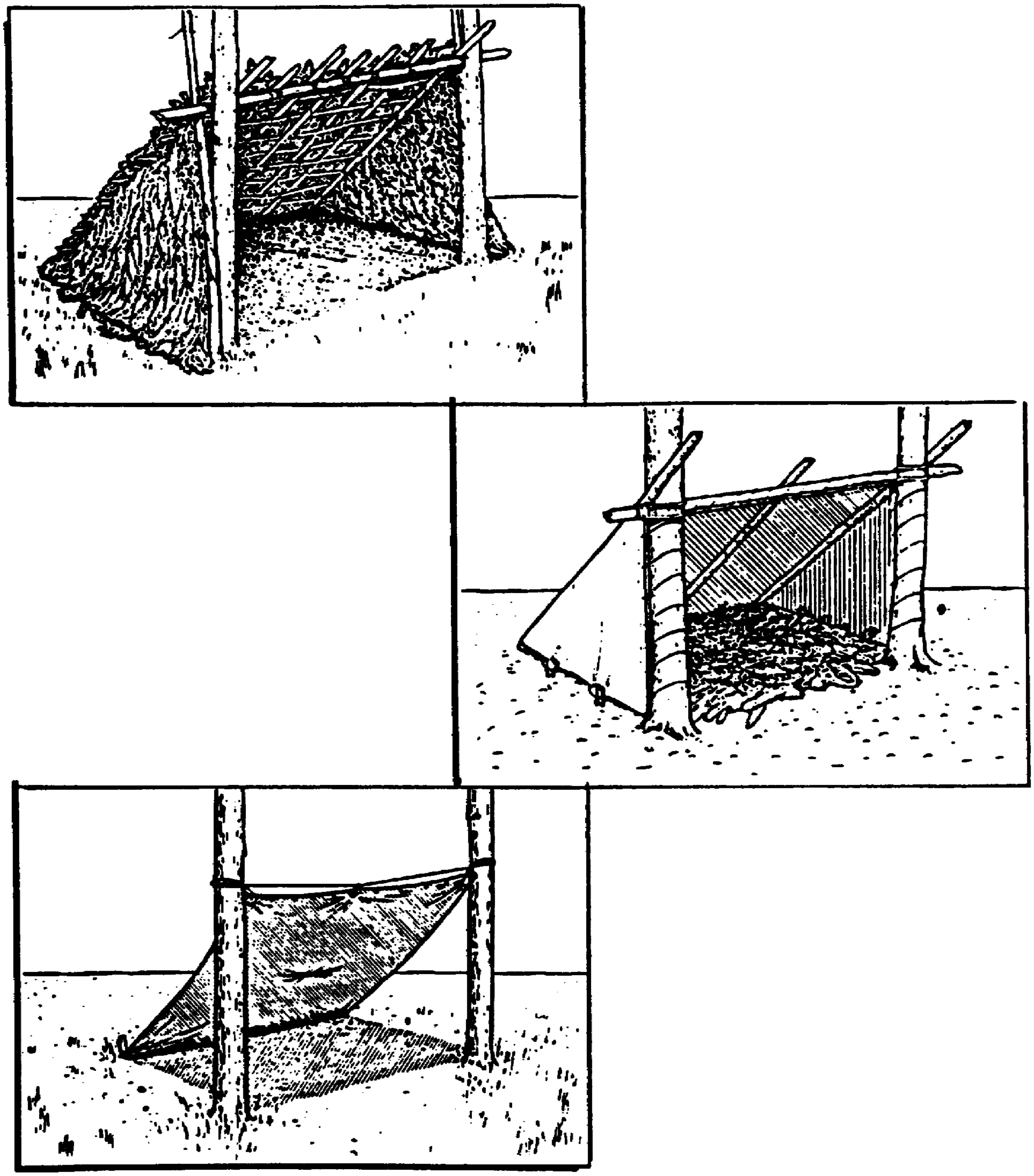

Figure 22. Lean-to shelters.

MATERIALS NEEDED

A sturdy, long smooth ridge pole (longer than the builder's body) long enough to span the distance between two sturdy trees
10-foot support poles
Stakes
Lines
Buttons
Fabric material
A rain fly, bed, and other refinements

PROCEDURE

STEP 1: Lash the ridge pole between two suitable trees at about cheek or shoulder height.

STEP 2: Lay the roof support poles on the ridge pole so the roof support poles and the ground are at approximately a 60-degree angle.

STEP 3: Lash the roof support poles to the ridge pole.

STEP 4: Place the middle seam of the fabric on the middle support pole with the lower lateral band along the ridge pole.

STEP 5: Tie-off the middle and both sides of the lower lateral band approximately 8 to 10 inches from the ridge pole.

STEP 6: Stake the middle and rear of the shelter first, then alternate stakes from side to side. The stakes that go up the sides to the front should point to the front of the shelter.

STEP 7: Pull the lower lateral band closer to the ridge pole with indian lacing. (Indian lacing is sewing or lacing the lower lateral band with line secured to the bipod poles.) This removes the remaining wrinkles and further tightens the material.

STEP 8: Add bed and other refinements (reflector fire, bed logs, or rain fly).

Figure 23. Lean-to construction.

c. Sod Shelter. A sod house is strong and fireproof. A framework covered with sod provides a shelter that is warm in cold weather and is easily made waterproof and insect-proof in the summer. The framework must be strong. It can be made from poles, willow, or driftwood (some natives use whale bones). The roots of sod with heavy grass or weed growth tend to hold the soil together. Cutting about 2 inches of soil along with the grass is sufficient. The size of the blocks are determined by the strength of the individual.

d. Thermal.

(1) All thermal shelters use a layering system consisting of the frame, fabric (if available), boughs or shrubs, and snow. The framework must be sturdy enough to support the cover and insulation. Use door block to minimize heat loss. Add insulation on sleeping areas.

(2) If a barren land-type shelter is being built with only snow, a long knife or digging tool is a necessity. It normally takes two to three hours of hard work to dig a snow cave and much longer for the novice to build an igloo. No matter which shelter is used, take a digging tool into the shelter at night to cope with the great amount of snow that may block the door during the night.

(3) Dress lightly while digging and working. You can easily become overheated and dampen your clothing with perspiration which rapidly turns to ice.

(4) If possible, position thermal shelter openings 90 degrees to the prevailing wind. The entrance to the shelter should also be screened with snow blocks stacked in an L-shape.

(5) Snow on sea ice, suitable for cutting into blocks, is usually found on the lee side of ice hills or ridges. Packed snow is often so shallow that snow blocks have to be cut out horizontally.

10. MAINTENANCE AND IMPROVEMENTS

Once a shelter is constructed, it must be maintained. Additional modifications may make the shelter more effective and comfortable. Indian lacing (lacing the front of the shelter to the bipod) tightens the shelter. A door may help block the wind and keep insects out. Other modifications may include a fire reflector, porch or work area, or another addition such as an opposing lean-to.

11. WARM CLIMATE SHELTERS

a. The first step is deciding the shelter type required. No matter which shelter is selected, the building or improvising process should be planned, orderly, and follow proven procedures and techniques.

b. The <u>second step</u> is to select, collect, and prepare all materials needed before actual construction; this includes framework, covering, bedding or insulation, and implements to secure the shelter, such as lines, stakes, and weighted anchors.

(1) The poles or wood selected for shelters that use a wooden framework should have all the rough edges and stubs removed. Not only does this reduce the chances of the fabric being ripped, but it eliminates the chances of personal injury.

(2) On the outer side of a tree selected as a natural shelter, some or all of the branches may be left in place. These make good support structures for the rest of the shelter parts.

(3) Many materials can be used as framework coverings. These materials include ponchos, tarpaulins, or any other fabric. Some items used as framework and covering are the bark peeled off dead trees; boughs cut off trees; and palm, bamboo, grasses, and other vegetation cut or woven into desired patterns.

(4) If parachute material is to be used alone or in combination with natural materials, it must be changed slightly. Remove all of the lines from the parachute and then cut it to size. This eliminates bunching and wrinkling and reduces leakage.

c. The <u>third step</u> is site preparation. This includes brushing away rocks and twigs from the sleeping area and cutting back overhanging vegetation.

d. The <u>fourth step</u> is to actually construct the shelter, beginning with the framework. Framework is very important; it must be strong enough to support the weight of the covering and any precipitation buildup of snow. It must also be sturdy enough to resist strong wind gusts.

(1) Construct the framework in one of two ways. For natural shelters, branches may be securely placed against trees or other natural objects. For parachute shelters, poles may be lashed to trees or other poles. The support poles or branches can then be layed or attached depending on their function. The framework determines the shelter pitch and controls its size. A 60-degree pitch is optimum for shedding precipitation and providing shelter room. The size of the shelter is controlled by the framework. The shelter should be large enough for survivors to sit up with adequate room to lie down and to store all personal equipment.

(2) After the basic framework is complete, apply and secure the framework covering. The care and techniques used to apply the covering determine the effectiveness of the shelter in shedding precipitation.

(a) Remember that "pitch and tightness" apply to shelters designed to shed rain or snow. Parachute material, for example, is porous and does not shed moisture unless it is stretched tightly at an angle of sufficient pitch (40 to 60 degrees) to encourage run-off instead of penetration. When using parachute material on shelters, remove all suspension line from the material. Excess line can be used for lashing and sewing. Next, stretch the center seam tightly, then work from the back of the shelter to the front, alternating sides and securing the material to stakes or framework by using buttons and lines. When stretching the material tightly, pull the material 90 degrees to remove wrinkles. If the material is not stretched tightly, any moisture pools in the wrinkles and leaks into the shelter. Do not touch the material when water is running over it as this breaks the surface tension at that point and allows water to drip into the shelter. Two layers of parachute material, 4 to 6 inches apart, create a more effective water repellent covering. Even during hard rain, the outer layer only lets a mist penetrate if it is pulled tightly. The inner layer then channels off any moisture that may penetrate. This layering of parachute material also creates a dead-air space that covers the shelter. This is especially beneficial in cold areas when the shelter is enclosed. Adequate insulation is also provided by boughs, snow, aircraft parts, and so forth. These are discussed in more depth in the paragraphs on cold climate shelters. A double layering of parachute material helps to trap body heat, radiant heat from the earth's surface, and other heating sources.

(b) If natural materials are used for the covering, use the shingle method. Starting at the bottom and working toward the top of the shelter, overlap the bottom of each piece over the top of the preceding piece. This allows water to drain off. Place the material on the shelter in sufficient quantity so that survivors in the shelter cannot see through it.

12. HOT CLIMATE SHELTERS

a. Tropical. In moist tropical areas, major environmental factors influence site selection and shelter types. Those factors include rain, heat, insects, wet ground, mud-slide areas, moisture and dampness, and dead standing trees and limbs. Nights are cold in some mountainous tropical areas. Try to stay out of the wind and build a fire. Reflecting the heat off a rock pile or other barrier is a good idea. Some natural materials that can be used in the shelters are green wood (dead wood may be too rotten), bamboo, and palm leaves. Vines can be used in place of a suspension line for thatching roofs or floors. Banana plant sections can be separated from the banana plant and fashioned to provide a mattress.

(1) Campsite. Survivors should establish a campsite on a knoll or high spot in an open area well back from any swampy or marshy area. The ground in these areas is drier, and there may be a breeze which would result in fewer insects. Clear underbrush and dead vegetation from the shelter site. Crawling insects are not able to approach as easily if there is no cover for them. A thick bamboo clump or matted canopy of vines for cover reflects the smoke from the campfire and discourages insects. This cover also keeps the extremely heavy early morning dew off the bedding.

(2) Shelter.

(a) The easiest improvised shelter is made by draping a poncho, parachute, or tarpaulin over a rope or vine stretched between two trees. Keep one end of the canopy higher than the other; insects are discouraged by smudge fires when there are few openings in shelters. A hammock made from parachute material keeps you off the ground and discourages ants, spiders, leeches, scorpions, and other pests.

(b) In the wet jungle, you need shelter from dampness. If you stay with the aircraft, it should be used for shelter. Try to make it mosquito-proof by covering openings with netting or parachute cloth.

(c) An A-frame shelter is very effective in protecting the survivor from rain (Figure 24). As with other shelter types constructed with natural coverings, begin lashing the covering material to the bottom of the A-frame first.

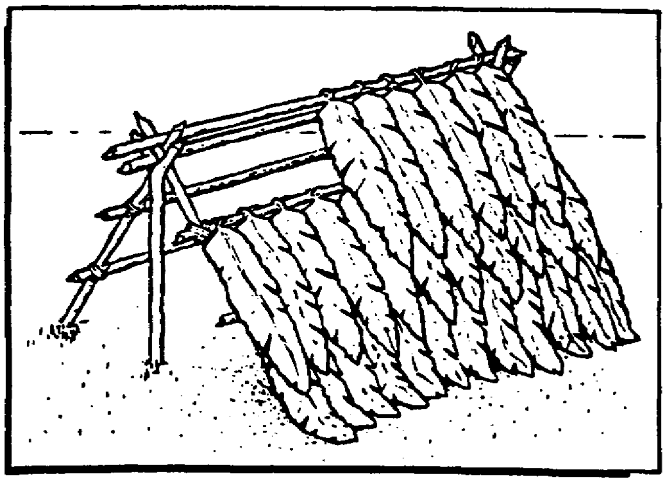

Figure 24. Banana leaf A-frame.

(d) The raised platform shelter has many variations. One example is four trees or vertical poles in a rectangular pattern a little longer and a little wider than the survivor and can protect any equipment he has. Two long, sturdy poles are then square lashed between the trees or vertical poles, one on each side of the intended shelter. Cross pieces can then be secured across the two horizontal poles at 6- to 12-inch intervals. This forms the platform on which a natural mattress may be constructed. Use parachute material as an insect net, and build a roof over the structure using A-frame building techniques. Waterproof the roof with thatching laid bottom to top in a thick shingle fashion. Figure 25 shows examples of this and other platform shelters. These shelters can also be built using three trees in a triangular pattern. At the foot of the shelter, two poles are joined to one tree.

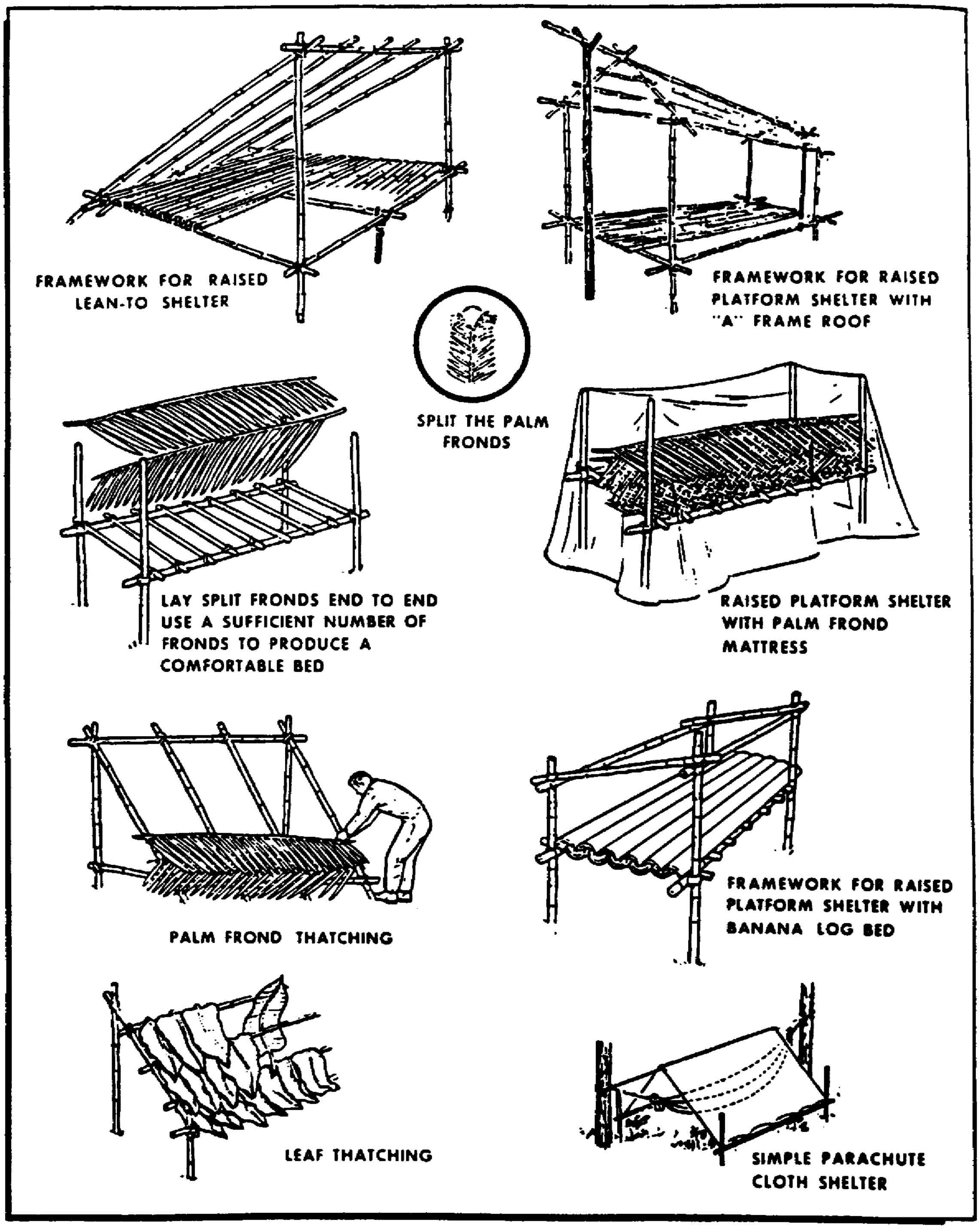

Figure 25. Raised platform shelter.

(e) A variation of the platform shelter is the raised poncho-platform. A quick and comfortable bed is made by simply wrapping material around the two frame poles. Another method is to roll poles in the material in the same manner as for an improvised stretcher (Figure 26).

(f) On tropical coasts and other coastal environments, if a more permanent shelter is desired, as opposed to a simple shade shelter, survivors should build a hobo shelter (Figure 27). To build this shelter, follow the instructions in Figure 28.

b. Desert. Natives of hot, dry areas make use of light-proof shelters with sides rolled up to take advantage of any breeze. You should emulate these shade shelters if forced to survive in these areas. Consider the extremes of heat and cold in hot areas, as most can become very cold during the night. The major problem during early morning, late evening, or at night for survivors is escaping the heat and the sun's rays. Build shelters during early morning, late evening, or at night and on the windward sides of dunes for cooling breezes. However, potential survivors should recall that survivors who come down in a desert area during daylight hours must be immediately concerned with protection from the sun and loss of water. In this case, drape parachute canopy material over liferaft, vegetation, or a natural terrain feature for a quick shelter.

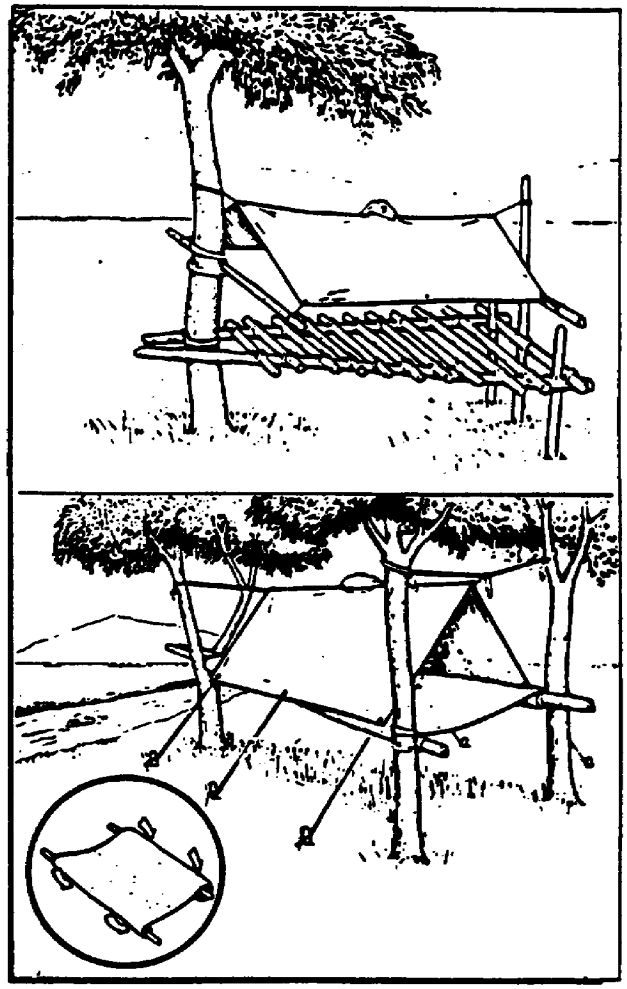

Figure 26. Raised poncho platform shelter.

(1) Natural.

(a) Natural shelters are often limited to the shade of cliffs and the lee sides of hills, dunes, or rock formations. In some desert mountains, it is possible to find good rock shelters or cave-like protection under tumbled blocks of rocks that have fallen from cliffs. Use care to ensure that these blocks are in areas void of future rock falling activity and free from animal hazards.

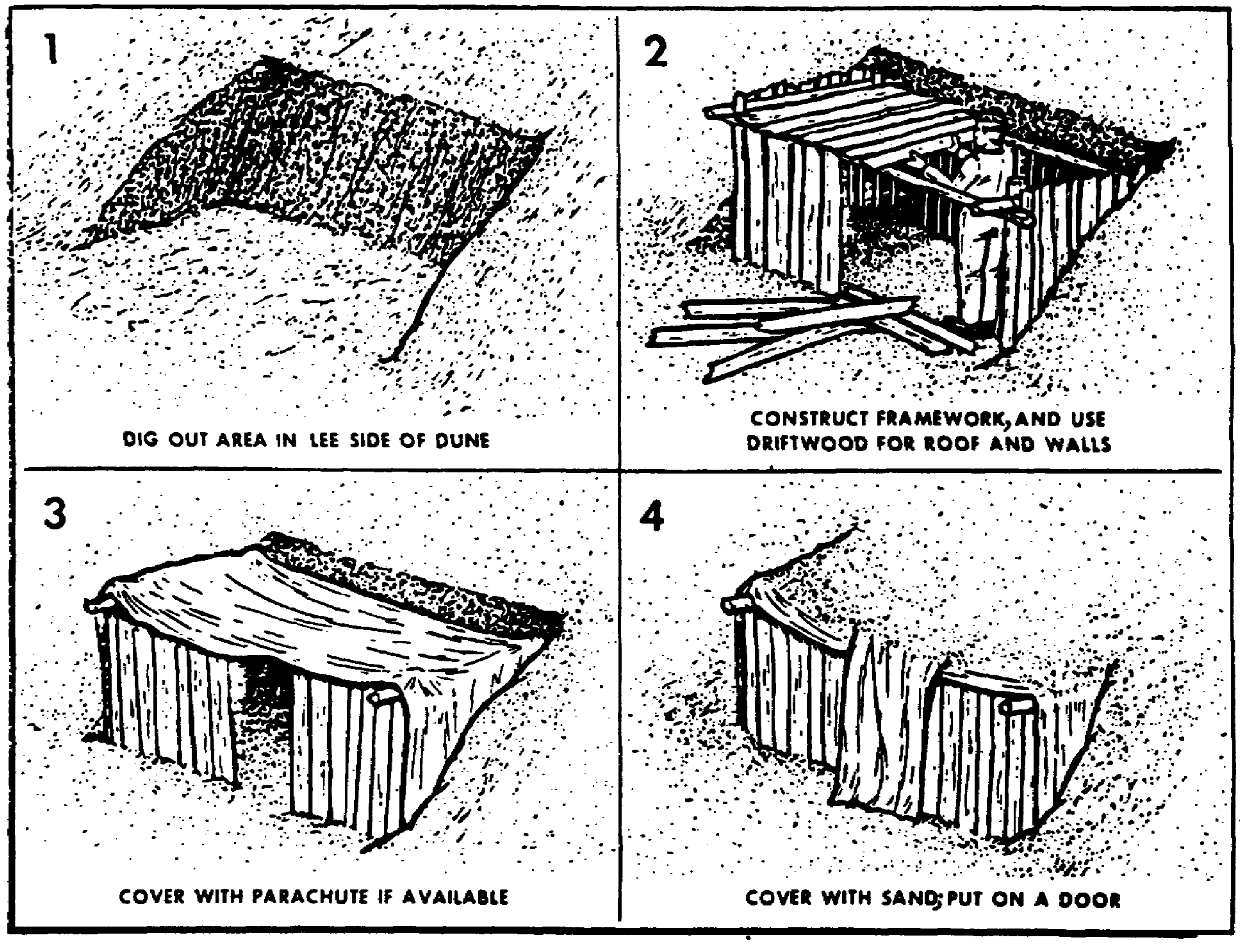

Figure 27. Hobo shelter.

(b) Vegetation, if any exists, is usually stunted and armed with thorns. It may be possible to stay in the shade by moving around the vegetation as the sun moves. The hottest part of the day may offer few shadows because the sun is directly overhead. Parachute material draped over bushes or rocks provides some shade.

(2) Constructed.

(a) Materials that can be used in constructing desert shelters include sand, rock, life rafts, aircraft ,parts, vegetation, and parachute suspension lines. Sand, though difficult to work with when loose, may be made into pillars by using sandbags made from parachute or any available cloth. Rock and vegetation (sage brush, creosote bushes, Juniper trees, and desert gourd vines) are valuable building materials. Parachute canopy and suspension lines are perhaps the most versatile building materials available. When used in layers, parachute material protects survivors from the sun's rays. Aircraft parts and life rafts can be used for shade shelters. Survivors may use sections of the wing, tail, or fuselage to provide shade. However, the interior of the aircraft quickly becomes superheated and should be avoided as a shelter. An inflatable raft tilted against a raft paddle or natural object, such as a bush or rock, provides relief from the sun (Figure 29).

Materials

digging tool **driftwood or boards** **fabric**

Procedure

STEP 1: **Dig into the lee side of a sand dune to protect the shelter from the wind.**

STEP 2: **Clear a level area large enough to lie down in and store equipment.**

STEP 3: **Build a heavy driftwood framework which will support the sand.**

STEP 4: **Wall the sides and top with strong material (boards or driftwood) that will support the sand; leave a door opening.**

STEP 5: **Slope the roof to equal the slope of the sand dune.**

STEP 6: **Cover the entire shelter with parachute material to keep sand from sifting through small holes in the walls and roof.**

STEP 7: **Cover the fabric with 6 to 12 inches of sand to provide protection from wind and moisture.**

STEP 8: **Construct a door for the shelter.**

Figure 28. Hobo shelter construction.

(b) In a hot desert, build shelters away from large rocks that store heat during the day. You may need to move to rocky areas during the evening to take advantage of the warmth that heated rocks radiate. In warmer deserts, use lighter-colored materials as an outer layer and darker-colored material as an inner layer for protection from ultraviolet rays. In cooler areas, use multiple layers of material with darker colored material as the outer layer to absorb heat.

(c) Make the shelter from dense material or with numerous layers to reduce or stop dangerous ultraviolet rays and to reduce the inside temperature. The colors of the parachute materials make a difference as to how much protection is provided from ultraviolet radiation. As a general rule, the order of preference should be to use as many layers as practical in the order of orange, green, tan, and white. The layers should be kept approximately 12 to 18 inches apart or above the individual (Figure 30). This allows the air to cool the underside of the material. Place the shelter floor about 18 inches above or below the desert surface to increase the cooling effect. The side of shelters should be movable in order to protect survivors during cold and/or windy periods and to allow for ventilation during hot periods.

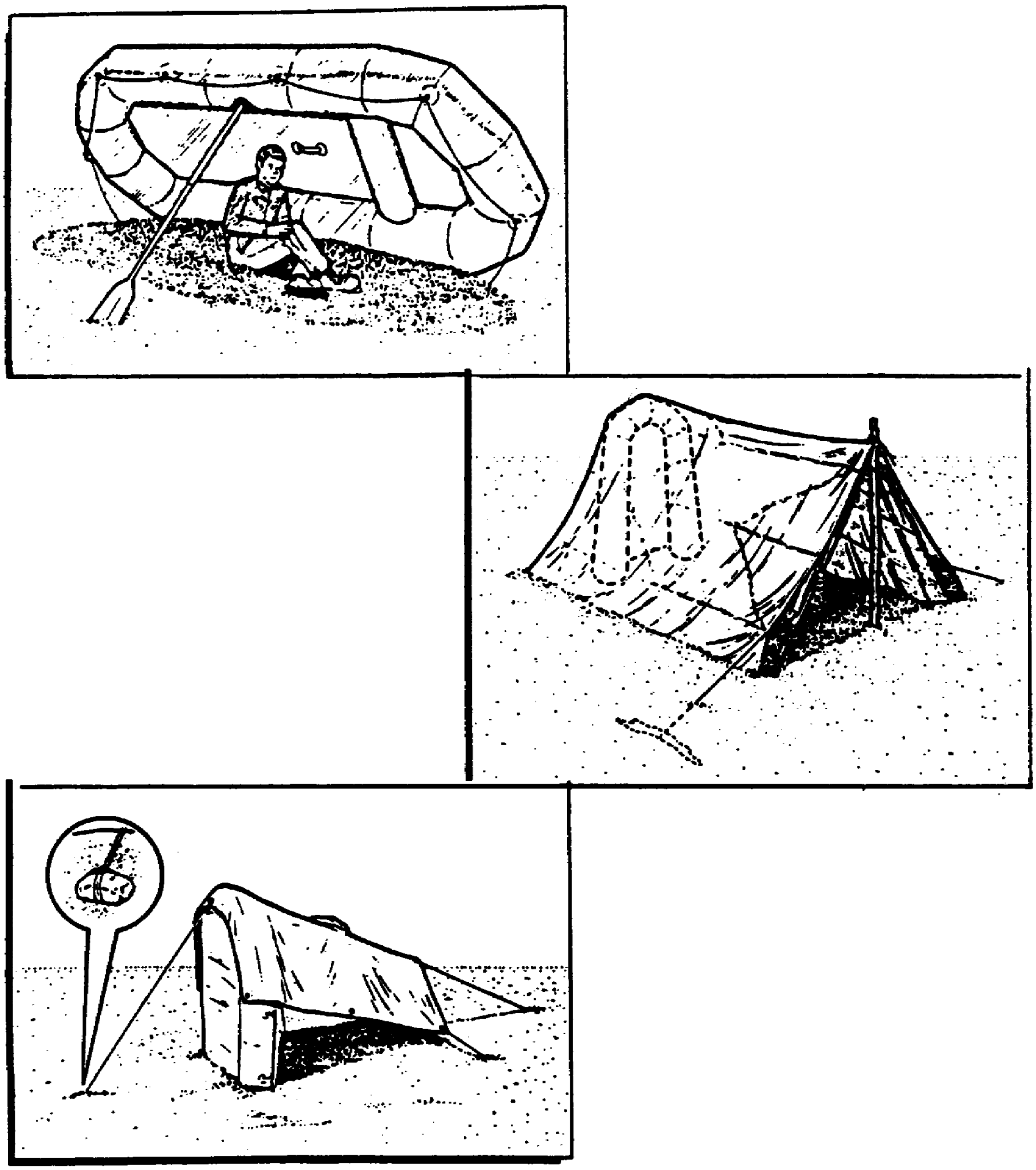

Figure 29. Improvised natural shade shelters.

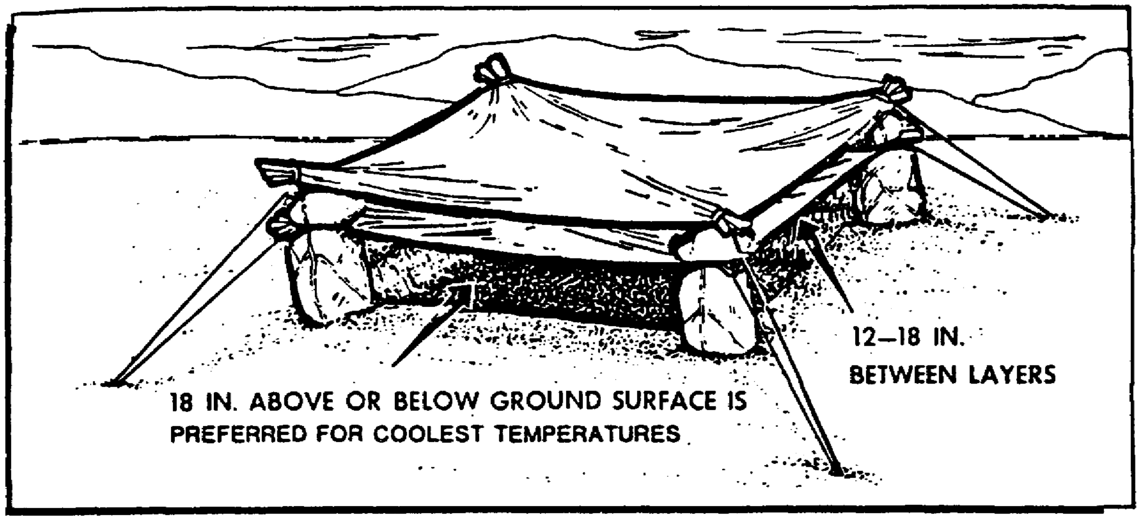

Figure 30. Desert shade shelter.

13. ARCTIC CLIMATE SHELTERS

a. Although protection from winter conditions, such as snow and ice, are predominant in an arctic climate, consider those problems encountered during the arctic summer. You need shelter against rain and insects. Stay away from thick vegetation, as mosquitoes and flies make life miserable. Choose a campsite near water but on high, dry ground if possible. A good campsite is a ridge top, cold lake shore, or a spot that gets a breeze.

(1) If you stay with the aircraft, it can be used for shelter during the summer. Cover the openings with netting or ponchos to keep insects out and cook outside to avoid carbon monoxide poisoning. Build fires a safe distance from the aircraft.

(2) An aircraft should not be used as a shelter when temperatures are below freezing except during high winds. Even then a thermal shelter should be constructed as soon as the conditions improve. The aircraft will not provide adequate insulation, and the floor usually becomes icy and hazardous.

(3) Many temperate area shelters are suitable for summer arctic conditions. The fan shelter (Figure 31) is especially good. It protects from precipitation and keeps insects out.

b. The differences between arctic and arctic-like environments create the need for different shelters. Basically, tree-line areas and barren lands may require special shelter characteristics or building principles before you have adequate shelter.

(1) In tree-covered areas, sufficient natural shelter building materials are normally available. Caution, however, is required. Shelters built near rivers and streams may be caught in an overflow. Tree-line area shelters include the fan (Figure 31), thermal A-frame (Figure 32), lean-to or wedge (Figure 33), double lean-to (Figure 34), willow frame (Figure 35), and tree well (Figure 36).

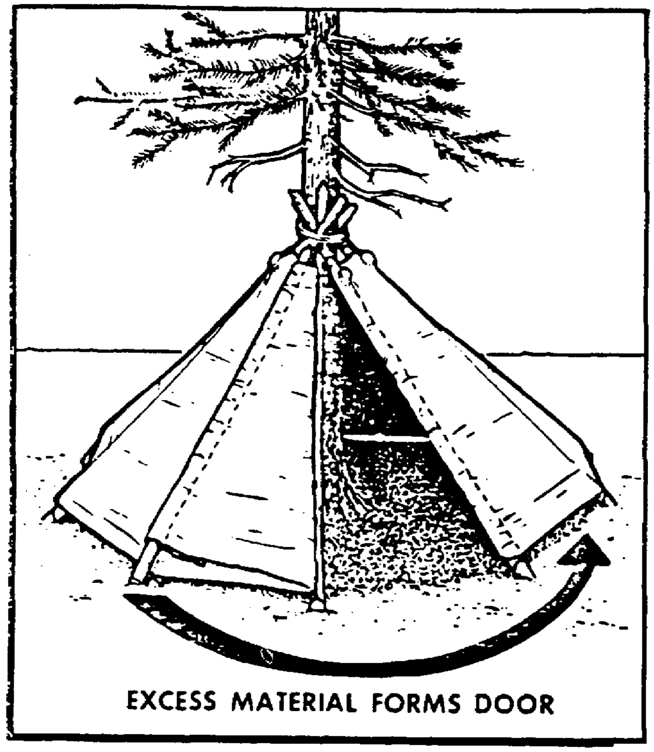

Figure 31. Fan shelter

(2) Barren lands include some seacoasts, icecaps, sea ice areas, and areas above the tree line. Barren lands, on the other hand, offer a limited variety of materials for shelter construction. These are snow, small shrubs, and grasses. Ridges formed by drifting or wind-packed snow may be used for wind protection (you should build on the lee side). In some areas, such as sea ice, windy conditions usually exist and cause the ice to shift, forming pressure ridges. Avoid these areas of unstable ice and snow at all times. Shelters suitable for barren-type areas include the snow cave (Figure 37), molded dome (Figure 38), fighter trench (Figure 39), and igloo (Figure 40). Those that are quick to construct and require minimum effort and energy are the molded dome, snow cave, and fighter trench. It is important to know which of these shelters is the easiest to build since reducing or eliminating the effect of the windchill factor is essential to remaining alive.

c. Regardless of the shelter type, use the thermal principles and the insulation for arctic shelters. Heat radiates from bare ground and ice masses over water. This means that shelter areas on land should be dug down to bare earth if possible (Figure 41). You need a minimum of 8 inches of insulation above them to retain heat. Seal openings except ventilation holes to avoid heat loss. Especially important is leaving vent holes open if heat-producing devices are used. Candles, Sterno, or small oil lamps produce carbon monoxide. In addition to t e ventilation hole through the roof, another may be required at the door to ensure adequate air circulation. As a general rule, unless you can see your breath, the snow shelter is too warm and should be cooled down. Otherwise, the snow or ice will melt and drip.

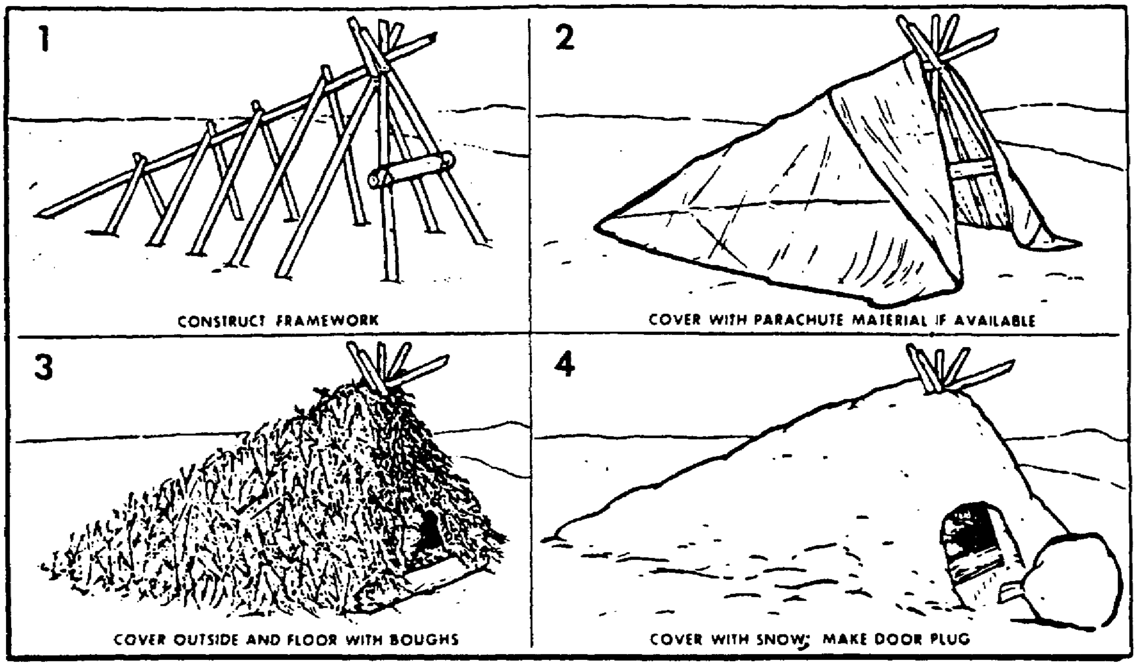

Figure 32. Thermal A-frame.

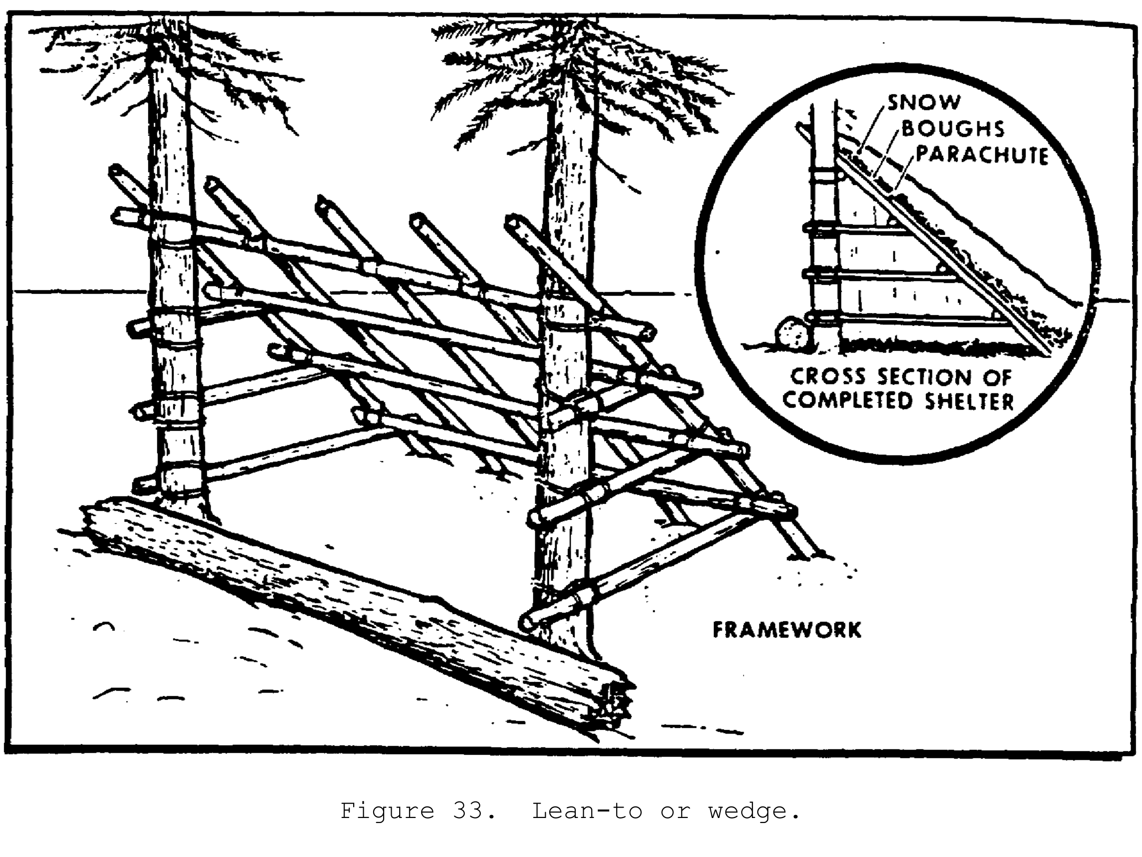

Figure 33. Lean-to or wedge.

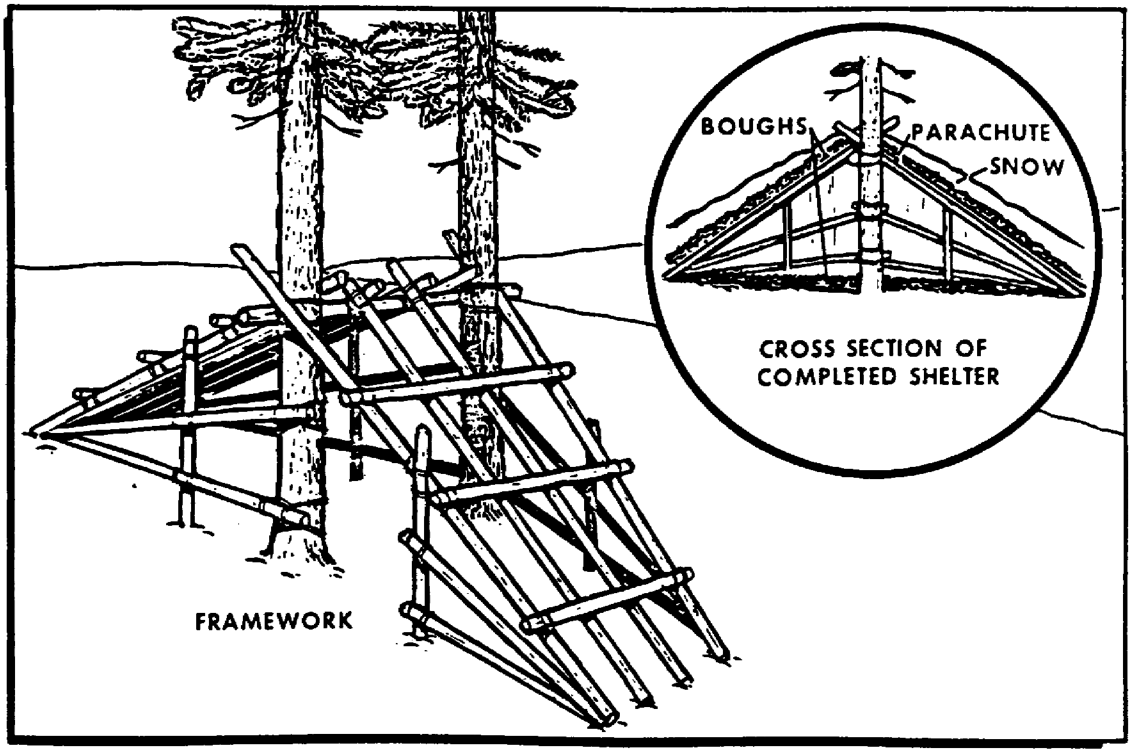

Figure 34. Double lean-to.

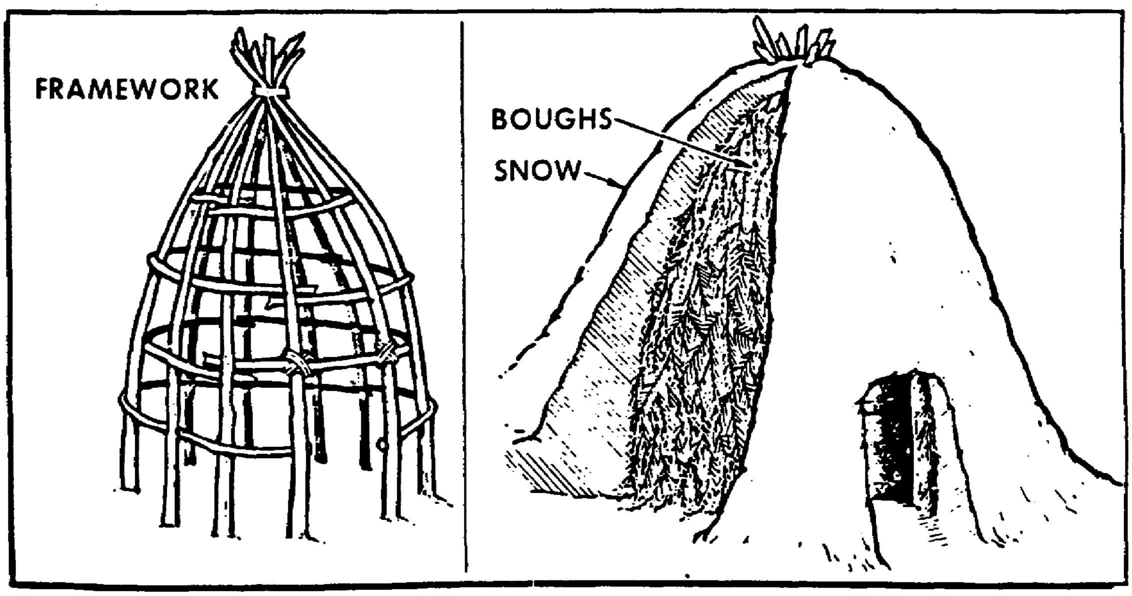

Figure 35. Willow frame shelter.

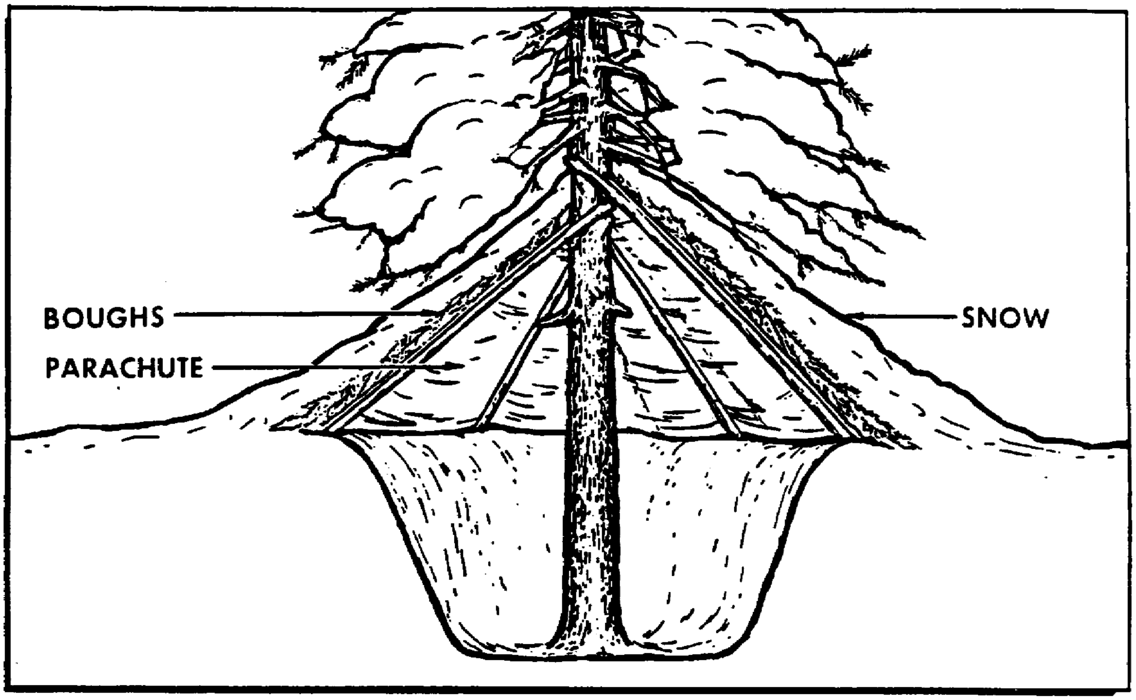

Figure 36. Tree well shelter.

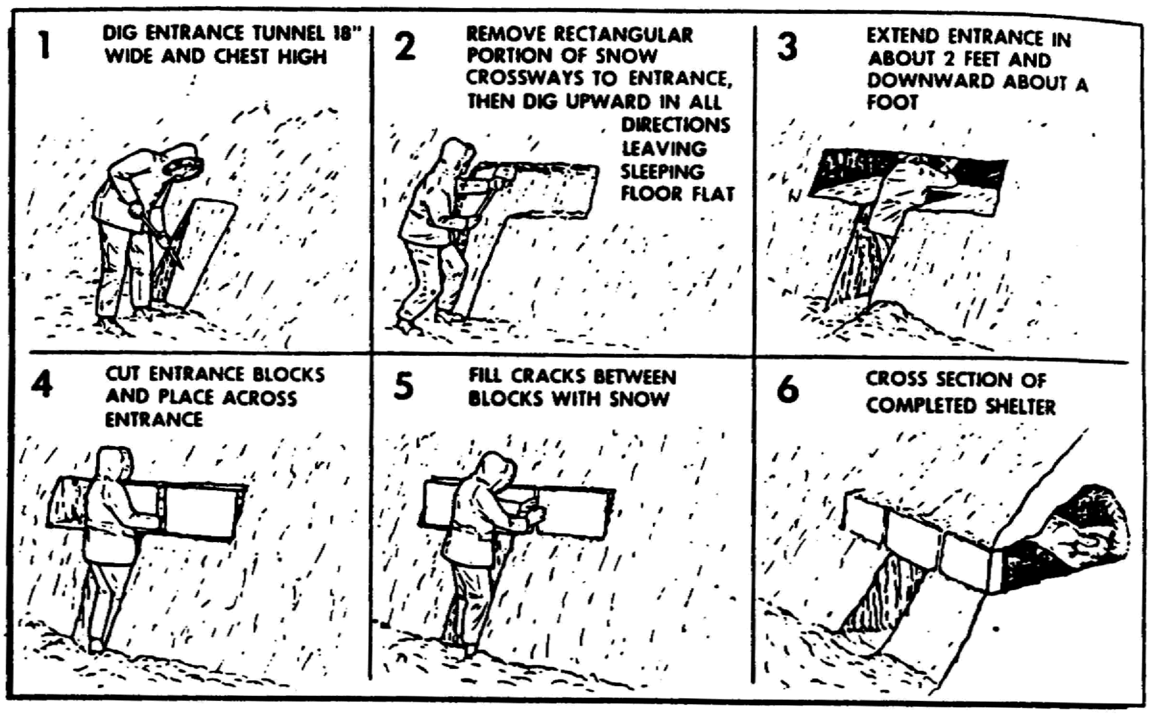

Figure 37. Snow cave.

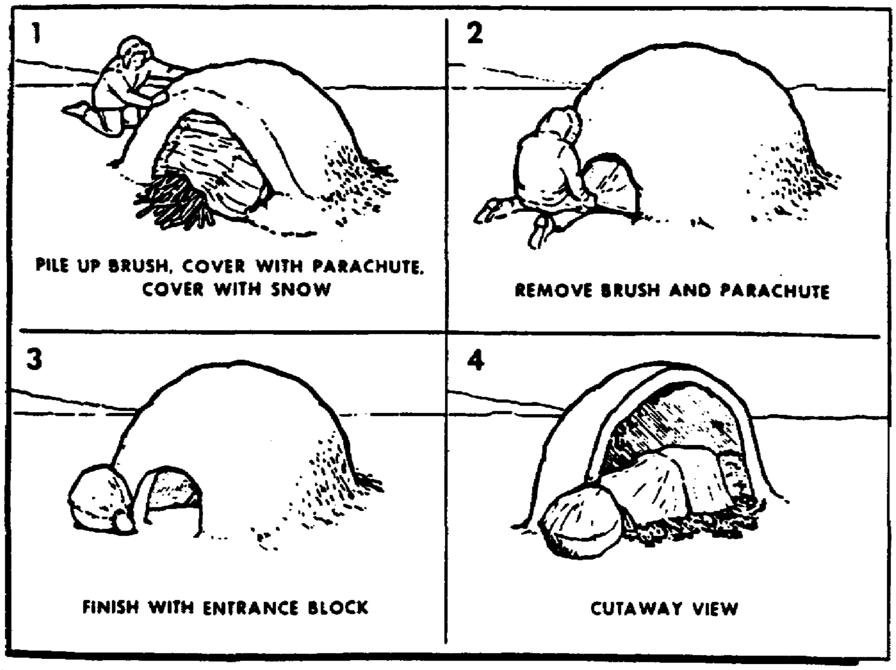

Figure 38. Molded dome shelter.

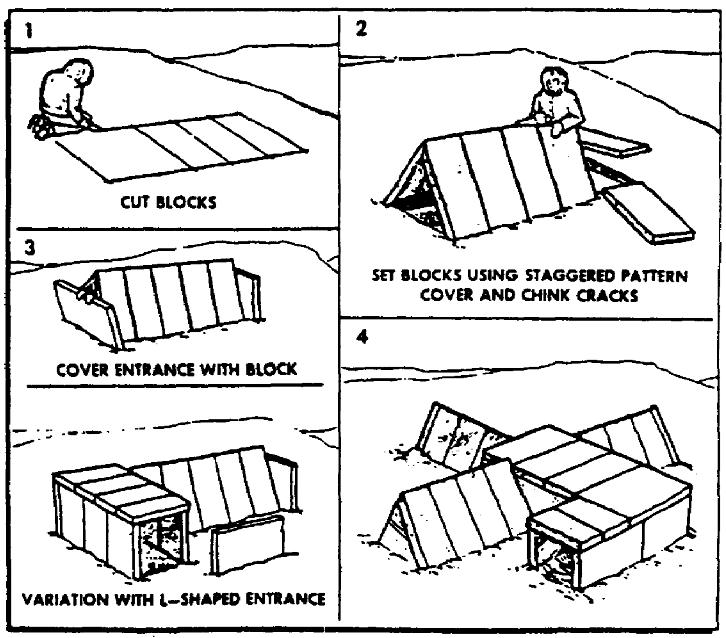

Figure 39. Fighter trench.

d. Although the outside air ay be extremely cold,-the temperature inside a small well-constructed snow cave is probably not lower than -10°F. Body heat alone can raise the temperature of a snow cave 45 degrees above the outside air. A burning candle raises the temperature 4 degrees. Burning Sterno (small size, 2 5/8 ounces) raises the cave temperature about 28 degrees. However, snow shelters provide a rather rugged life since they cannot be heated many degrees above freezing. Once the inside of the shelter glazes over with ice, it reduces the insulating quality of the shelter. Therefore, remove this layer of ice by chipping it off or build a new shelter. Maintain the old shelter until the new one is constructed as it provides protection from the wind.

14. OPEN SEA SHELTERS

Personal protection from the elements is just as important on the seas as it is anywhere else. Some rafts come equipped with canopies, spray shields, and insulated floors to protect you from heat, cold, and water. If rafts are not so equipped or the equipment has been lost, try td improvise these items using clothing, parachute material, or other equipment.

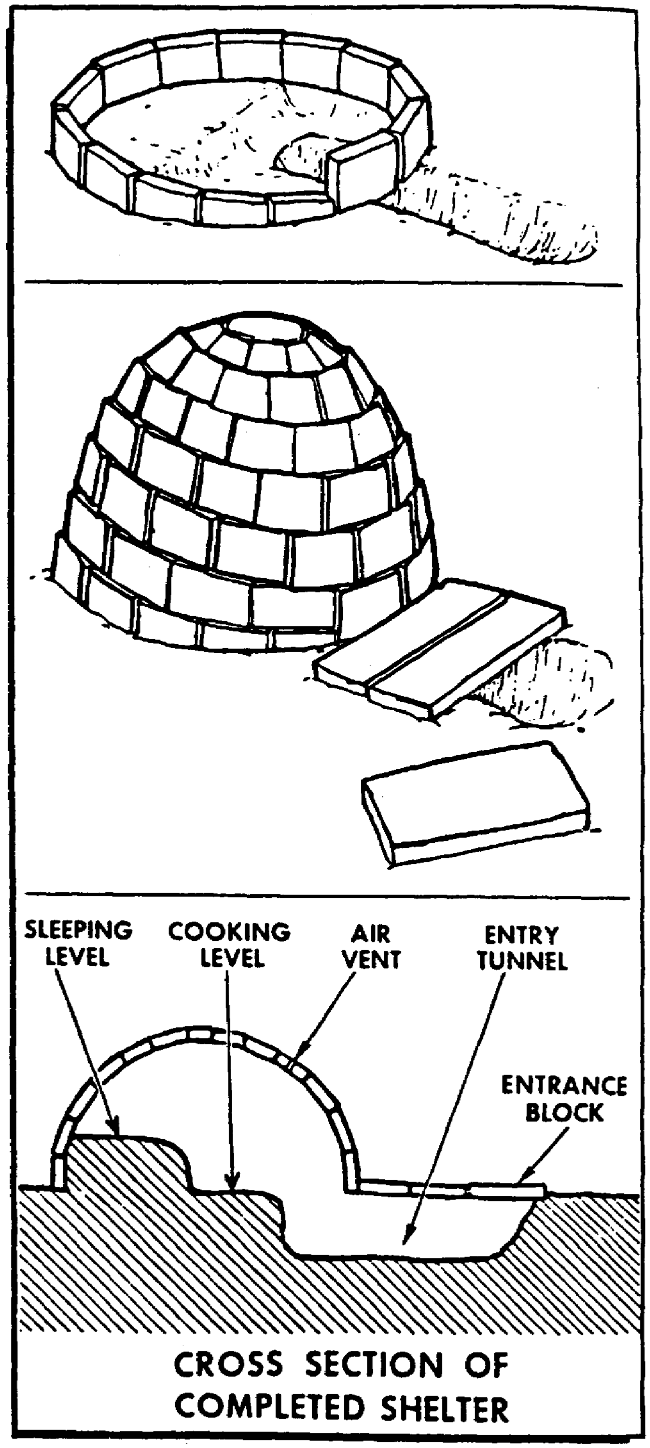

Figure 40. Igloo.

Figure 41. Scraping snow to the bare earth.

15. SHELTER LIVING

a. You should limit the number of shelter entrances to conserve heat. Fuel is generally scare in the arctic. To conserve fuel, it is important to keep the shelter entrance sealed as much as possible (Figure 42). Activities, such as gathering fuel and snow or ice for melting, should be accomplished only when it is necessary to go outside the shelter. To expedite matters, a trash receptacle may be kept inside the door. Equipment may be stored in the entryway. Necessities that cannot be stored inside may be kept just outside the door. Any firearms (guns) you may have must be stored outside the shelter to prevent condensation build up that could cause them to malfunction.

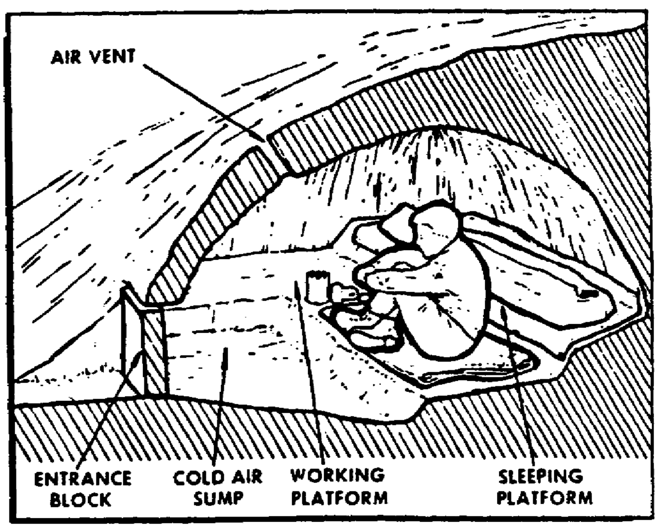

Figure 42. Snow cave shelter living.

b. A standard practice in snow shelter living is for people to relieve themselves indoors when possible. This practice conserves body heat. If the snowdrift is large enough to dig connecting snow caves, one may be used as a toilet room. If not, tin cans may be used for urinals and snow blocks for solid waste (fecal matter).

c. You should use thick insulation under yourself when sleeping or resting even if you have a sleeping bag. Use a thick bough bed constructed in shingle-fashion, seat cushions, parachute, or an inverted and inflated rubber raft. Outer clothing also makes good mattress material. A parka makes a good footbag. The shirt and inner trousers may be rolled up for a pillow. Socks and insoles can be separated and aired in the shelter. Drying may be completed in the sleeping bag by stowing them around the hips. Only use this drying method as a last resort.

d. Keeping the sleeping bag clean, dry, and fluffed gives maximum warmth. To dry the bag, turn it inside out, beat out the frost, and warm it before the fire--taking care that it doesn't burn. To keep moisture (from breath) from wetting the sleeping bag, improvise a moisture cloth from a towel, a piece of clothing, or parachute fabric. It can then be lightly wrapped around the head in such a way that the breath is trapped inside the cloth. Remember that a piece of fabric dries easier than a sleeping bag. If cold is experienced during the night, exercise by fluttering your feet up and down or by beating the inside of the bag with your hands. Food or hot liquids can be helpful.

e. Snow remaining in clothing melts in a warm shelter. When the clothing is again taken outside, the moisture turns to ice and reduces the CLo value. Be sure to brush clothes before entering the shelter. Under living conditions where drying clothing is difficult, it is easier to keep clothing from getting wet than having to dry it later. If all the snow cannot be eliminated from outer clothing, remove the clothing and store it in the entry way or on the floor away from the source of heat so it remains cold. If ice should form in clothing, it may be beaten out with a stick.

f. In the cramped quarters of any small emergency shelter, pots of liquid or drink can be accidentally kicked over. The cooking area, even if it is only a Sterno stove, should be located out of the way, possibly in a snow alcove.

Section III. FIRECRAFT

16. FIRE ELEMENTS

You must carefully weigh the advantages of building a fire against the possibility of being detected and captured by the enemy. If enemy contact is possible, it may not be practical to build a fire, unless life-threatening environmental extremes exist. If you decide to build a fire, make every effort to conceal the heat source and use fuel sources that produce the least amount of smoke. There are three essential elements for successful fire building: fuel, heat, and oxygen. These combined elements are referred to as the "fire triangle." By limiting fuel, only a small fire is produced. If the fire is not fed properly, there is too much or too little fire. Green fuel is difficult to ignite; therefore, the fire must be burning well before it is -used for fuel. Heat and oxygen must be accessible to ignite any fuel. Even though these elements are necessary, you must take your time and prepare well. Preparing all of the stages of fuel and all of the parts of the fire-starting apparatus is the key. To be successful at firecraft, you need to practice and be patient!

a. Fuel. Fuels used in building a fire normally fall into three categories (Figure 43) that relate to their size and flash point: tinder, kindling, and fuel.

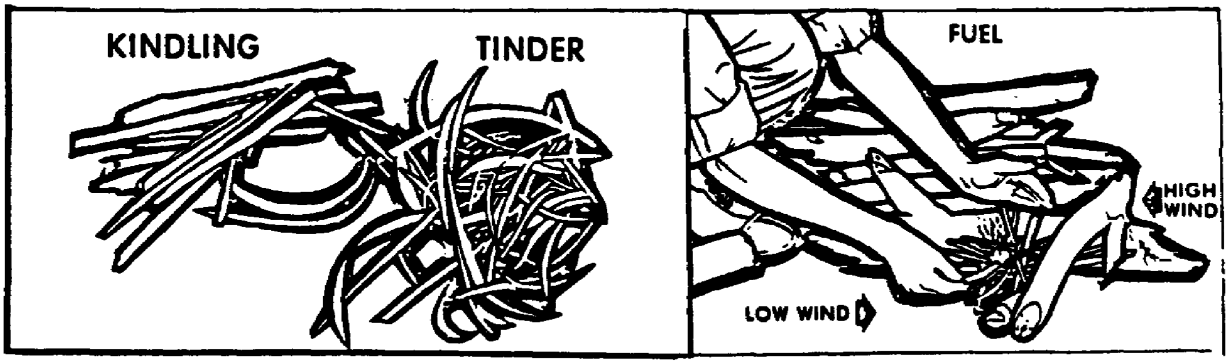

Figure 43. Stages of a fire.

(1) Tinder is any type of small material having a low flash point. It is easily ignited with minimum heat, even a spark. Tinder must be arranged to allow air (oxygen) between the hair-like, bone-dry fibers. One of the most important parts of firecraft is preparing the tinder for fire. Dry tinder is so critical that pioneers used extreme care to have some in a waterproof "tinder box" at all times. It may be necessary to have two or three stages of tinder to get the flame to a useful size. Tinders include those listed in Figure 44.

(2) Kindling is the next larger stage of fuel material and should also have a high combustible point. It is added to, or arranged over, the tinder in such a way that it ignites when the flame from the tinder reaches it. Kindling is used to bring the burning temperature up to a point where larger and less combustible fuel material can be used. Kindling includes those items listed in Figure 45.

(3) Fuel, unlike tinder and kindling, does not have to be kept completely dry as long as there is enough kindling to raise the fuel to a combustible temperature. The fuel type used determines the amount of heat and light the fire produces. The best method to determine which fuel is

best is by trial and error. After identifying the burning properties of available fuel, select the type needed. Weather plays an important role when selecting fuel. Remember to protect all fine materials from moisture to prevent excessive smoke production. Also, highly flammable liquids should not be poured on an existing fire. Even a smoldering fire causes the liquids to explode and inflict serious burns.

PAPER
STEEL WOOL
FOAM RUBBER
CHARRED CLOTH
RESINOUS SAWDUST
COTTON BALLS OR LINT
BIRD OR RODENT NEST LININGS
CRUSHED FIBERS FROM DEAD PLANTS
CEDAR, BIRCH BARK, OR PALM FIBER
SHREDDED BARK FROM SOME TREES AND BUSHES
SEED DOWN (MILKWEED, CATTTAIL, OR THISTLE
FINE, DRY WOODSHAVINGS AND STRAW OR GRASSES
DRY POWDERED SAP FROM THE PINE TREE FAMILY (PITCH)
VERY FINE PITCH WOODSHAVINGS (RESINOUS WOOD FROM PINE OR SAPPY CONIFERS)

Figure 44. Tinder.

DEAD, DRY, SMALL TWIGS OR PLANT FIBERS

DEAD, DRY, THINLY SHAVED PIECES OF WOOD, BAMBOO, OR CANE (Always split bamboo as sections can explode.)

CONIFEROUS SEED CONES AND NEEDLES

"SQUAW WOOD" FROM THE UNDERSIDE OF CONIFEROUS TREES (dead, small branches next to the ground sheltered by the upper live part of the tree)

PIECES OF WOOD REMOVED FROM THE INSIDE OF LARGER PIECES

SOME PLASTICS (the spoon from an in-flight ration)

WOOD SOAKED OR DOUSED WITH FLAMMABLE MATERIALS (wax, insect repellent, petroleum fuels, and oil)

STRIPS OF PETROLATUM GAUZE FROM A FIRST-AID KIT

DRY SPLIT WOOD (This type wood burns readily because it is drier inside. The angular portions of the wood burn easier than the bark-covered round pieces because they expose more surface to the flame. Splitting all fuels causes them to burn more readily.)

Figure 45. Kindling.

(a) Good sources. Standing or leaning wood is usually dry inside even if it is raining. In tropical areas, avoid selecting wood from trees that grow in swampy areas or those covered with mosses. Dry standing dead wood and dry dead branches (those that snap when broken) are easy to split and break. They can be pounded on a rock or wedged between other objects and bent until they break. The insides of fallen trees and large branches may be dry even if the outside is wet. The heart wood is usually the last to rot. Dry, split, hardwood trees (oak, hickory, monkey pod, and ash) are less likely to produce excessive smoke. They usually provide more heat than soft woods, but they may also be more difficult to break into usable sizes. Green wood, found almost anywhere can be made to burn if it is finely split and mixed evenly with dry dead wood. In treeless areas you can find other natural fuels. Dry grasses can be twisted into bunches. Dead cactus and other plants are available in deserts. Dry peat moss is found along the surface of undercut stream banks. Dried animal dung, animal fats, and sometimes even coal is found on the surface. Also, oil impregnated sand can be used when available.

(b) Poor sources. Rotten wood is of little value since it smolders and smokes. Tropical soft woods are not usually a good fuel source. Pine and other conifers are fast-burning and produce smoke unless a large flame is maintained.

(c) Other fuels. On barren lands in the arctic, aircraft fuel may be the only material survivors have available for fire. Lubricating oil can be burned as fuel by using a wick arrangement. Make the wick of string, rope, rag, sphagnum moss, or even a cigarette. Place it on the edge of a receptacle filled with oil. Soak rags, wood, paper, or other fuel in oil and throw it on the fire. Seal blubber makes a satisfactory fire without a container if gasoline or heat tablets are available to provide an initial hot flame (Figure 46). Ignite the heat source on the raw side of the blubber while the fur side is on the ice. A square foot of blubber burns for several hours. Once the blubber catches fire, the heat tablets can be recovered. Eskimos light a small piece of blubber and use it to kindle increasingly larger pieces. The smoke from a blubber fire is black, dirty, and heavy; but the flame is very bright and can be seen for several miles. The smoke from blubber penetrates clothing and blackens the skin.

b. Heat. The need to start a fire may arise at the most inopportune time. One of the greatest aids you can have for rapid fire starting is the tinder box previously mentioned. A supply of matches, lighters, and other such devices only last a limited time. Once the supply is depleted, it cannot be used again. However, if possible before the need arises, you should become skilled at starting fires with more primitive means. Some very reliable methods are heat, friction, or a sparking device. For primitive methods to be successful, materials must be bone dry. Primitive people who use these ignition methods take great care to keep their tinder, kindling, and other fuels dry. Often they wrap many waterproof layers around their materials. Preparation, practice, and patience in using primitive fire-building techniques cannot be overemphasized. Be aware of the problems associated with the use of primitive heat sources. If the humidity is high in the immediate area, a fire may be difficult to ignite even if all other conditions are favorable. Another key point to remember in all primitive methods is to ensure that the tinder is not disturbed.

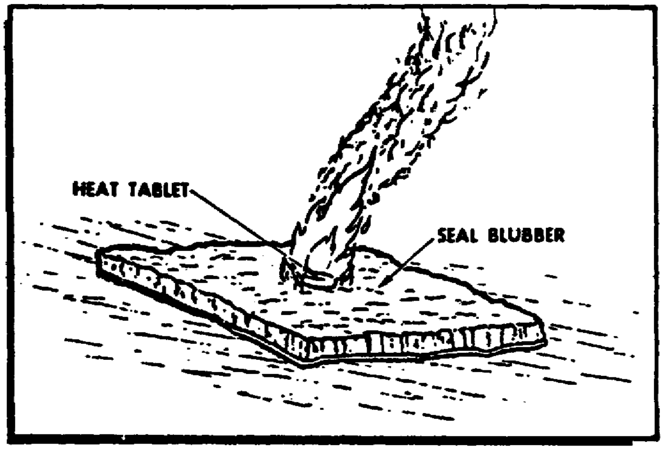

Figure 46. Heat tablet and seal blubber.

(1) Matches (or lighter).

(a) Arrange a small amount of kindling in a low pyramid close enough together so flames can jump from one piece to another. Leave a small opening for lighting and air circulation.

(b) Conserve matches by using a "shave stick" or a loosely tied bundle of thin, dry twigs. Shield the match from the wind while igniting the shave stick. Then apply the stick to the lover windward side of the kindling.

(c) Lay small pieces of wood or other fuel gently on the kindling before lighting or add as the kindling begins to burn. Then place smaller pieces first, adding larger pieces of fuel as the fire begins to burn. Avoid smothering the fire .by crushing the kindling with heavy wood.

(2) Flint and steel. Flint and steel is one way to produce fire without matches. To use this method, hold a piece of flint in one hand above the tinder. Then grasp the steel in the other hand and strike the flint with the edge of the steel in a downward glancing blow (Figure 47). The sparks must fall on the tinder and then be blown or fanned to produce a coal and subsequent flame. Cotton balls dipped in petroleum jelly make excellent tinder with flint and steel. When the tinder ignites, add additional tinder, kindling, and fuel.

(a) True flint is not necessary to produce sparks. Iron pyrite and quartz also give off sparks even if they are struck against each other. Check the area and select the best spark-producing stone as a backup for the available matches.

(b) Synthetic flint, such as the so-called metal match, consists of the same type of material used for flints in commercial cigarette lighters. Some contain magnesium that can be scraped into tinder and into which the spark is struck. The residue from the "match" burns hot and fast and compensates for some moisture in the tinder. If issued survival kits do not contain this item and you choose to make one rather than buy it, lighter flints can be glued into a groove in a small piece of wood or plastic. Then practice striking a spark by scratching the flint with a knife blade. A 90-degree angle between the blade and flint works best. Hold the device close enough for the sparks to hit the tinder, but allow enough distance to avoid accidentally extinguishing the fire.

(3) <u>Batteries</u>. Another method of producing fire is to use the battery of the aircraft or vehicle, storage batteries, and so forth. Use two insulated wires by connecting one end of a wire to the positive post of the battery and the end of the other wire to the negative post. Touch the two

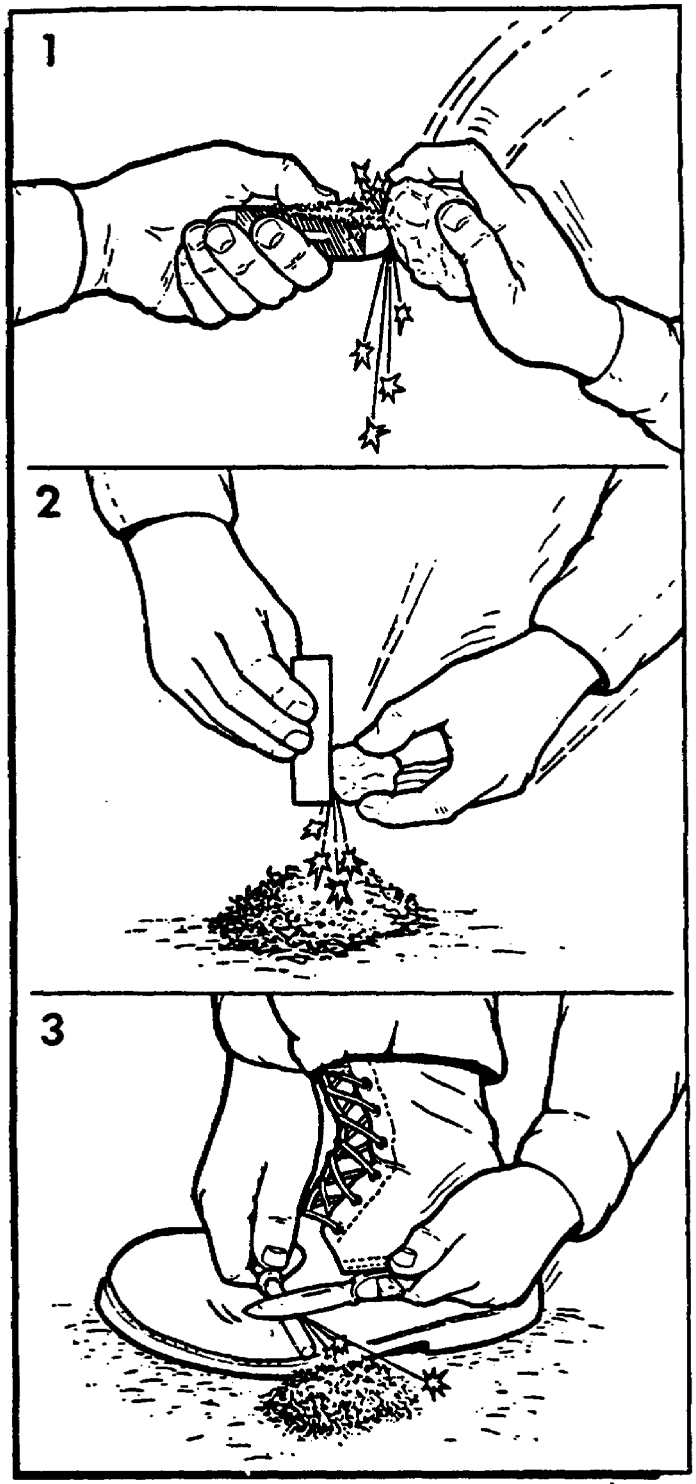

Figure 47. Fire starting with flint and steel.

remaining ends to the ends of a piece of noninsulated wire. This causes a short in the electrical circuit and the noninsulated wire begins to glow and get hot. Material coming in contact with this hot wire ignites. Use caution when attempting to start a fire with a battery as the battery produces hydrogen gas which can ignite from sparks or flames causing an explosion that could result in serious injury (Figure 48). If fine grade steel wool is available, start a fire by stretching it between the positive and negative posts until the wire itself makes a red coal. This technique works particularly well with two flashlight batteries.

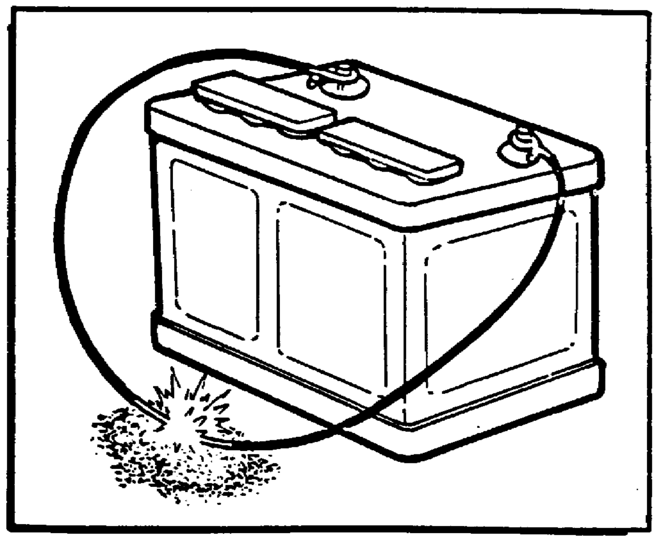

Figure 48. Fire starting with batteries.

(4) <u>Burning glass</u>. If you have sunlight and a burning glass, you can start a fire with very little physical effort (Figure 49). Concentrate the rays of the sun on the tinder by using the lens of a lensatic compass, a camera lens, or the lens of a flashlight which magnifies; even a convex piece of bottle glass may work. Hold the lens so that the brightest and smallest spot of concentrated light falls on the tinder. Once a wisp of smoke is produced, fan the tinder or blow on it until the smoking coal becomes a flame. Powdered charcoal in the tinder decreases the ignition time. Add kindling carefully as in any other type of fire. Practice reduces the time it takes to light the tinder.

(5) <u>Flashlight reflector</u>. You can also use a flashlight reflector to start a fire (Figure 50). Place the tinder in the center of the reflector where the bulb is usually located. Push it up from the back of the hole until the hottest light is concentrated on the end and smoke is seen. If a cigarette is available, use it as tinder for this method.

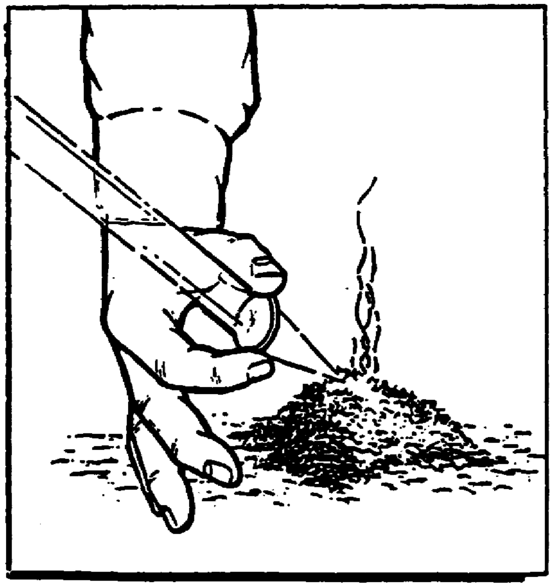

Figure 49. Fire starting with burning glass.

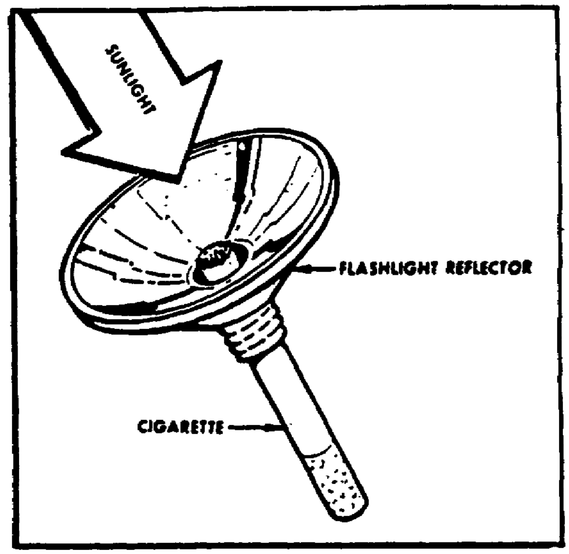

Figure 50. Firestarting with flashlight reflector.

(6) Bamboo fire saw.

(a) The bamboo fire saw is constructed from a section of dry bamboo with both end joints cut off. The section of bamboo, about 12 inches in length, is split in half lengthwise. The inner wall of one of the halves (running board) is scraped or shaved thin. This is done in the middle of the running board. A notch to serve as a guide is cut in the outer sheath opposite the scraped area of the inner wall. This notch runs across the running board at a 90 degree angle (Figure 51).

(b) The other half of the bamboo joint is further split in half lengthwise. One of the resultant quarters is used as a "baseboard." One edge of the baseboard is shaved down to make a tapered cutting edge. The baseboard is then firmly secured with the cutting edge up. This may be done by staking it to the ground in a manner that does not allow it to move.

(c) Tinder is made by scraping the outer sheath of the remaining quarter piece of the bamboo section. The scrapings (approximately a large handful) are then rubbed between the palms of the hands until all of the wood fibers are broken down and dust-like material no longer falls from the tinder. The ball of scrapings is then fluffed to allow maximum oxygen circulation through the mass. Place the finely shredded and fluffed tinder in the running board directly over the shaved area, opposite the outside notch. Then place thin strips of bamboo lengthwise in the running board to hold the tinder in place. Hold these strips stationary with your hands as you grasp the ends of the running board.

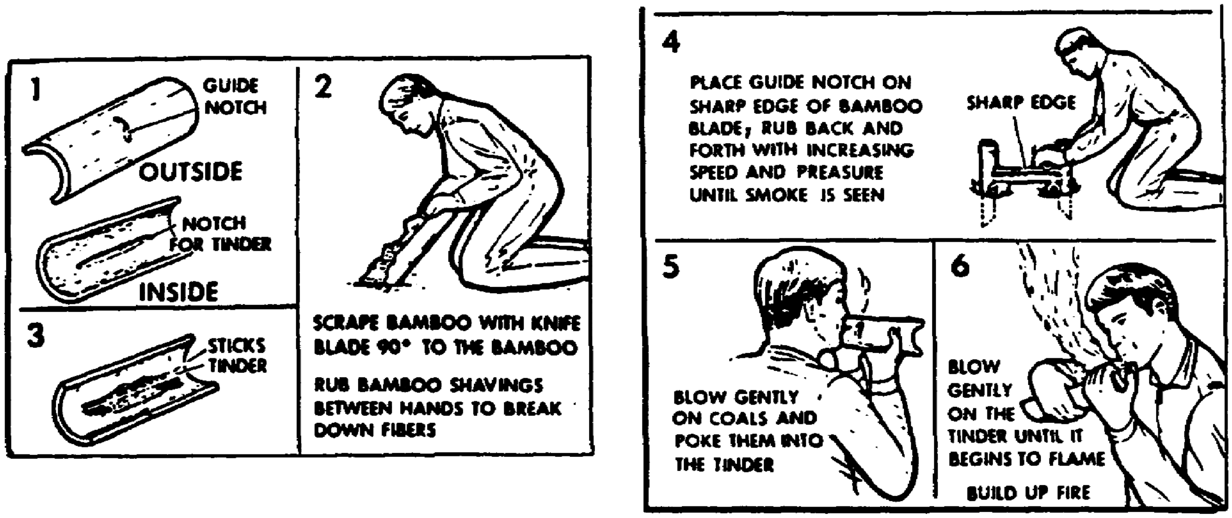

Figure 51. Bamboo fire saw.

(d) Prepare a long, very thin sliver of bamboo (the pick) for future use. Grasp one end of the running board in each hand, making sure the thin strips of bamboo are held securely in place. Place the running board over the baseboard at a right angle, so that the cutting edge of the baseboard fits into the notch in the outer sheath of the running board. Then slide the running board back and forth as rapidly as possible over the cutting edge of the baseboard. Use sufficient downward pressure to ensure enough friction to produce heat.

(e) As soon as billows of smoke rise from the tinder, pickup the running board. Use the pick to push the glowing embers from the bottom of the running board into the mass of tinder. While the embers are being pushed into the tinder, gently blow on the embers until the tinder bursts into flame.

(f) As soon as the tinder bursts into flame, slowly add kindling in small pieces to avoid smothering, the fire. Gradually add fuel to produce the desired fire size. If the tinder is removed from the running board as soon as it flames, the running board can be reused by cutting a notch in the outer sheath next to the original notch and directly under the scraped area of the inner wall.

(7) Bow and drill. This friction method has been used successfully for thousands of years. To be successful it requires a great deal of patience, dedication, and practice.

(a) Make a spindle of yucca, elm, basswood, or any other straight-grain wood (not softwood). Make sure that the wood is not too hard, or it will create a glazed surface when friction is applied. The spindle should be 12 to 18 inches long and 3/4 inch in diameter. The Sides should be octagonal, rather than round, to help create friction when spinning. Round one end and work the other end into a blunt point. The round end goes to the top on which the socket is placed. Make the socket from a piece of hardwood large enough to hold comfortably in the palm of the hand with the curved part up and the flat side down to hold the top of the spindle. Carve or drill a hole in this side and make it smooth so it will not cause undue friction and produce heat. Grease or soap can be placed in this hole to prevent friction (Figure 52).

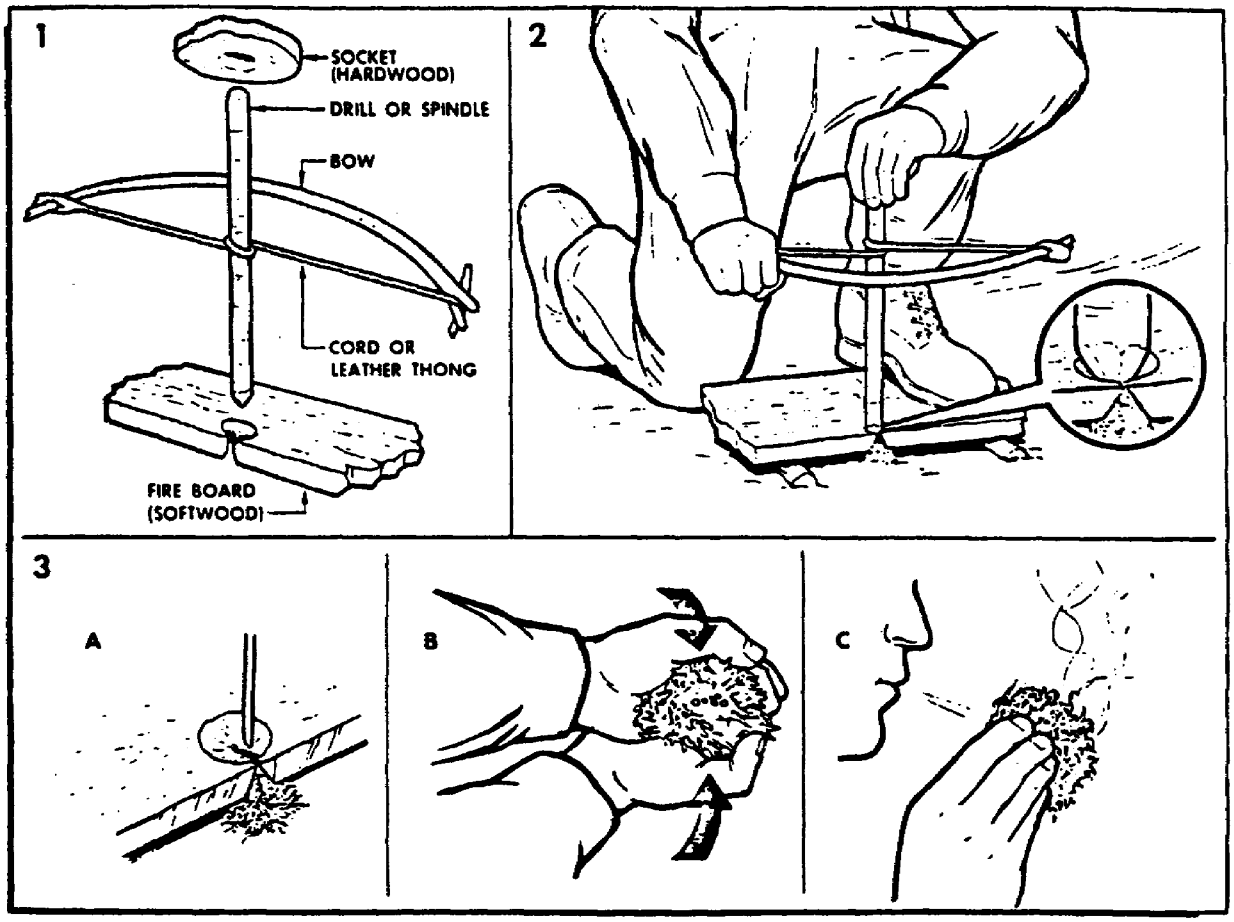

Figure 52. Bow and drill.

(b) Make the bow from a stiff branch about 3 feet long and 1 inch in diameter. This piece should have sufficient flexibility to bend, similar to a bow used to shoot arrows. Tie a piece of suspension line or leather thong to both ends so that it has the same tension as that of a bow. There should be enough tension for the spindle to twist comfortably.

(c) Make the fireboard from softwood and about 12 inches long, 3/4 inch thick, and 3 to 6 inches wide. Carve a small hollow in the fireboard. Make a V-shaped cut in from the edge of the board extending into the center of the hollow where the spindle will make the hollow deeper. The object of this "V" cut is to create an angle which cuts off the edge of the spindle as it gets hot and turns to charcoal dust. This is the critical part of the fireboard and must be held steady while spinning the spindle.

(d) While kneeling on one knee, place the other foot on the fireboard and place the tinder under the fireboard just beneath the V-cut. Take care to avoid crushing the tinder under the fireboard. Use a small 3/4-inch diameter stick to hold up the fireboard. This allows air into the tinder where the hot powder (spindle charcoal dust) is collected.

(e) Twist the bow string once around the spindle. Then place the spindle upright into the spindle hollow (socket). You may press the socket down on the spindle and fireboard. Hold the entire apparatus steady with the hand on the socket braced against the leg or knee. The spindle should begin spinning with long, even, slow strokes of the bow until heavy smoke is produced. Spin faster until the smoke is very thick. At this point, blow on the hot powder to produce a glowing ember. Remove the bow and spindle from the fireboard and place the tinder next to the glowing ember making sure not to extinguish it. Then roll the tinder gently around the burning ember, and blow into the embers to start the tinder burning. This part of the fire is most critical and should be done with care and planning.

(f) Place the burning tinder into the waiting fire "lay" containing more tinder and small kindling. At no time in this process should you break concentration or change sequence.

(8) The fire thong. The fire thong, another friction method, is used in only those tropical regions where rattan is found. This simple system consists of a twisted rattan thong or other strong plant fiber 4 to 6 feet long and less than 1 inch in diameter and a 4-foot length of dry wood that is softer than rattan (deciduous wood)(Figure 53). Rub with a steady but increasing rhythm.

(9) Ground stake. Another variation is the ground stake method. You can construct it by driving a stake into the ground (Figure 54, item 1).

(10) The plow. The plow method used by some primitives basically follows the principles of other friction methods (Figure 54, item 2). The wood used must not glaze when applying heat and must be able to produce powder with friction.

(11) Special equipment.

(a) Use the night end of the day-night flare as a fire starter. This means, however, that you must weigh the importance of a fire against the loss of a night flare.

Figure 53. Fire thong.

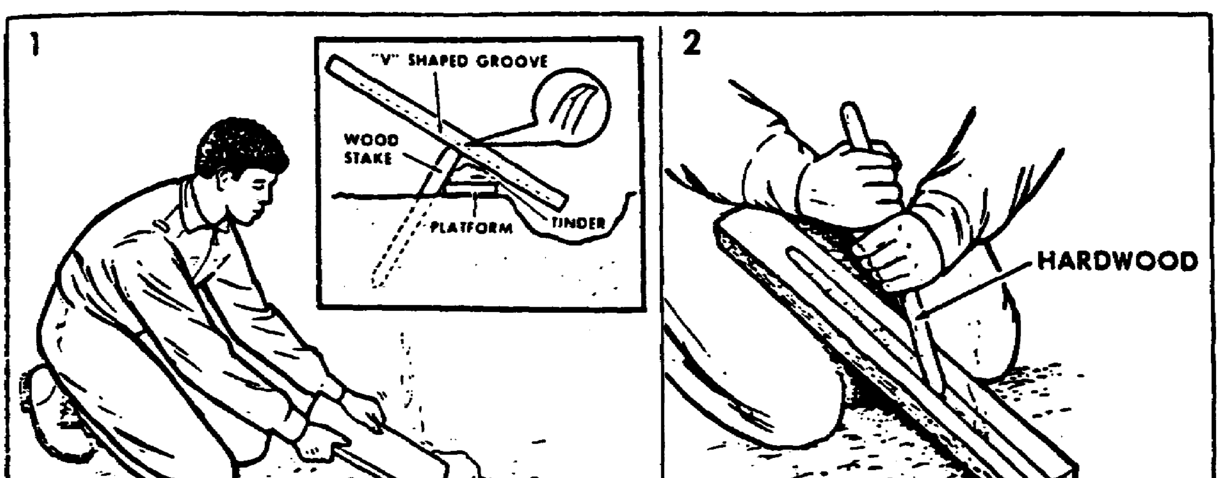

Figure 54. Fire plow.

(b) Some emergency kits contain small fire starters, cans of special fuels, windproof matches, and other aids. Save the fire starters for use during extreme cold and damp (moist) weather conditions.

(c) The white plastic spoon (packed in various in-flight rations) may be the type that burns readily. Push the handle deep enough into the ground to support the spoon in an upright position. Then light the tip of the spoon. It will burn for about 10 minutes (long enough to dry out and ignite small tinder and kindling).

(d) If a candle is available, ignite it to start a fire.

This prevents using more than one match. As soon as the fire is burning, extinguish the candle and save it for future use.

(e) Tinder is made more combustible by adding a few drops of flammable fuel or material. Mixing the powder from an ammunition cartridge with the tinder is an example. After preparing the tinder in this manner, store it in a waterproof container for future use. Use care in handling this mixture because the flash at ignition could burn the skin and clothing.

(f) For thousands of years, the Eskimos and other northern people have relied heavily on animal oils to heat their homes. The Eskimos use a fat stove or "Koodlik" to burn this fuel. You can improvise a stove from a ration can and burn any flammable oil-type liquid or animal fats available. Here again, keep in mind that if there is only a limited amount of animal fat, it should be eaten to produce heat inside the body rather than a fire starter.

17. FIRE CONTAINERS

a. You can make a stove of any empty waxed carton by cutting off one end and punching a hole in each side near the unopened end. Stand the carton on the closed end and loosely place the fuel inside the carton. Then light the stove using fuel material left hanging over the end. The stove will burn from the top down. You can also improvise a stove to burn fuel, lubricating oil, or a mixture of both (Figure 55). Place 1 or 2 inches of sand or fine gravel in the bottom of a can or other container and add fuel. Use care when lighting the fuel because it may explode. Cut slots into the top of the can to let flame and smoke out, and punch holes just above the level of the sand to provide a draft. A mixture of fuel and oil makes the fire burn longer. If no can is available, dig a hole and fill it with sand. Then pour fuel on the sand and ignite it. Do not allow the fuel to collect in puddles.

b. You only have a limited number of matches or other instant fire-starting devices. Therefore, in a long-term situation, you should use these devices sparingly or carry fire with you when possible. Many primitive cultures carry fire (fire bundles) by using dry punk or fibrous barks (cedar) encased in a bark. Others use torches. Natural fire bundles also work well for holding the fire. The natural fire bundle is constructed in a cross section as shown in Figure 56. There must be just enough oxygen to keep the coals inside the dry punk burning slowly. This requires constant vigilance to control the rate of the burning process.

18. FIRE LOCATION

Carefully select your fire location. An old story told of a mountain man who used his last match to light a fire built under a snow-covered tree. The heat from the fire melted the snow which slid off the tree and put out the fire. For a survivor, this type of accident can be very demoralizing or even deadly. Locate and prepare your fire carefully.

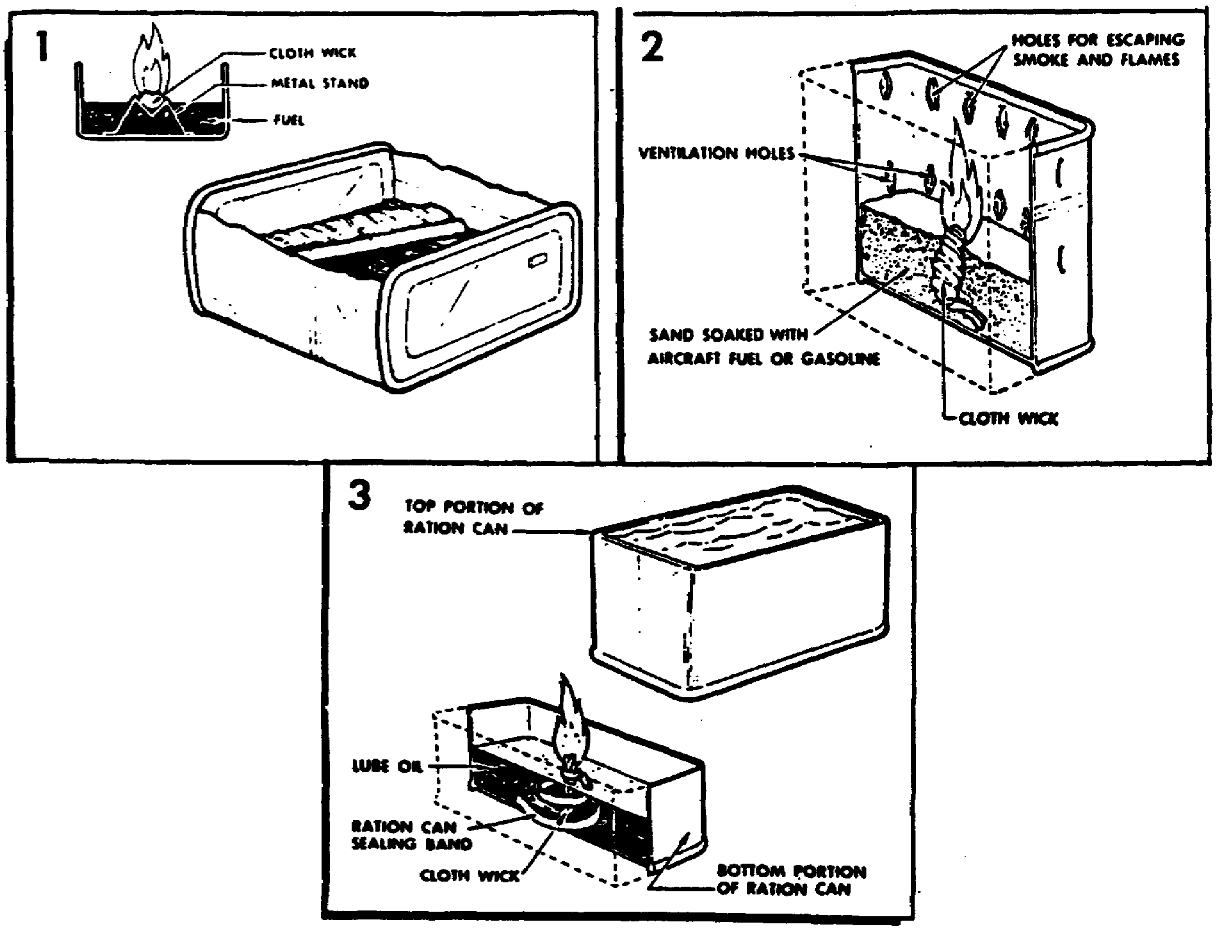

Figure 55. Fat and oil stoves.

a. After locating a site, twigs, moss, grass, or duff (decayed matter) should be cleaned away. Scrape at least a 3-foot diameter area down to the bare soil for even a small fire. A larger fire requires a larger area. If the fire must be built on snow, ice, or wet ground, build a platform of green logs or rocks.

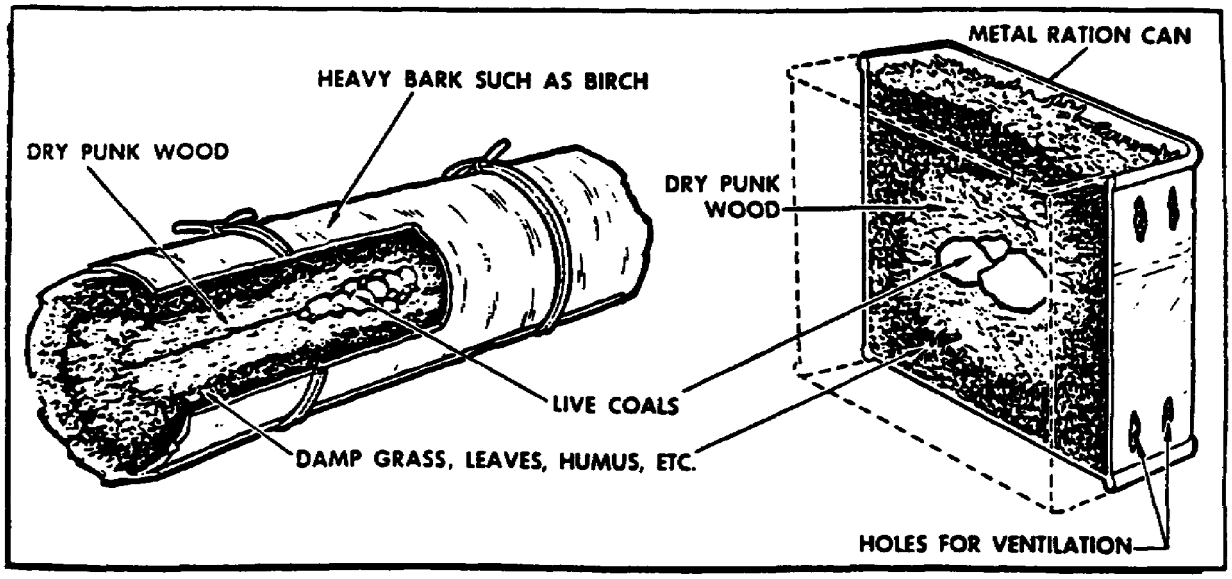

Figure 56. Fire bundles.

<u>NOTE</u>: Beware of wet or porous rocks; they may explode when heated.

b. There is no need to dig a hole or make a circle of rocks to prepare for fire building. However, rocks may be placed in a circle and filled with dirt, sand, or gravel to raise the fire above the moisture of the wet ground. The purpose of these rocks is only to hold the platform.

c. To get the most warmth from the fire, build it against a rock or log reflector (Figure 57). This directs the heat into the shelter. Wall-in cooking fires by using logs or stones. This provides a platform for cooking utensils and serves as a windbreak to help keep the heat confined.

d. After preparing the fire, place all materials together and arrange by size (tinder, kindling, and fuel). As a rule of thumb, you should have three times the amount of tinder and kindling than is necessary for one fire. It is to your advantage to have too much than not enough. Having plenty of material on hand prevents the possibility of the fire going out while additional material is gathered.

19. FIRE LAYS

Most fires are built to meet specific needs or uses--either heat, light, or preparing food and water. Configurations below are the most commonly used for fires and serve one or more needs (Figure 58).

a. <u>Tepee</u>. The tepee fire can be used as a light source and has a concentrated heat point directly above the apex of the tepee. This location is ideal for boiling water.

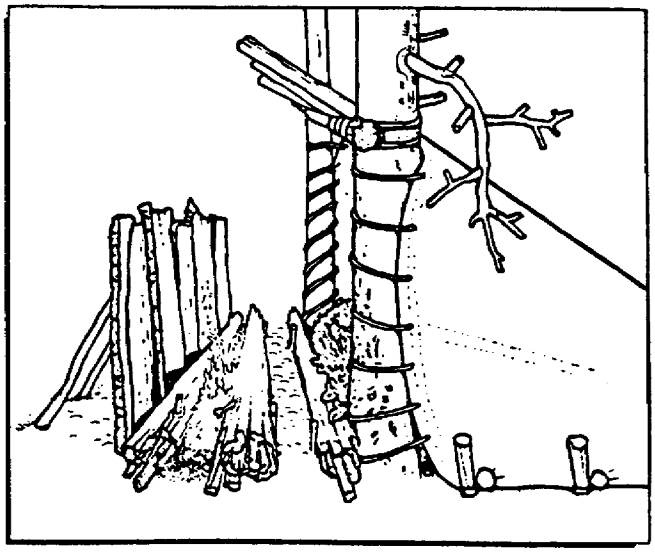

Figure 57. Fire reflector.

(1) To build the tepee, place a large handful of tinder on the ground in the middle of the fire site. Push a stick into the ground, slanting it over the tinder. Then lean or circle kindling sticks against the slanting stick, like a tepee, with an opening toward the windward side for draft.

(2) To light the fire, crouch in front of the fire lay with your back to the wind. Feed the fire from the downwind side, first with thin pieces of fuel and then gradually with thicker pieces. Continue feeding the fire until it has reached the desired size. The tepee fire has one big drawback. It tends to fall over easily. However, it serves as an excellent starter fire.

b. Log Cabin. As the name implies, this lay looks similar to a log cabin. Log cabin fires give off a great amount of light and heat primarily because of the amount of oxygen that enters the fire. The log cabin fire creates a quick and large bed of coals and can be used for cooking or as the basis for a signal fire. If one person or a group of people are going to use the coals for cooking, the log cabin can be modified into a long or keyhole fire.

c. Long fire.

(1) The long fire begins as a trench; the length is layed to take advantage of existing wind. The long fire can also be built above ground by using two parallel green logs to hold the coals together. These logs should be at least 6 inches in diameter and situated so the cooking utensils can rest upon the logs. Place two 1-inch thick sticks under both logs, one at each end of the long fire, to allow the coals to receive more air.

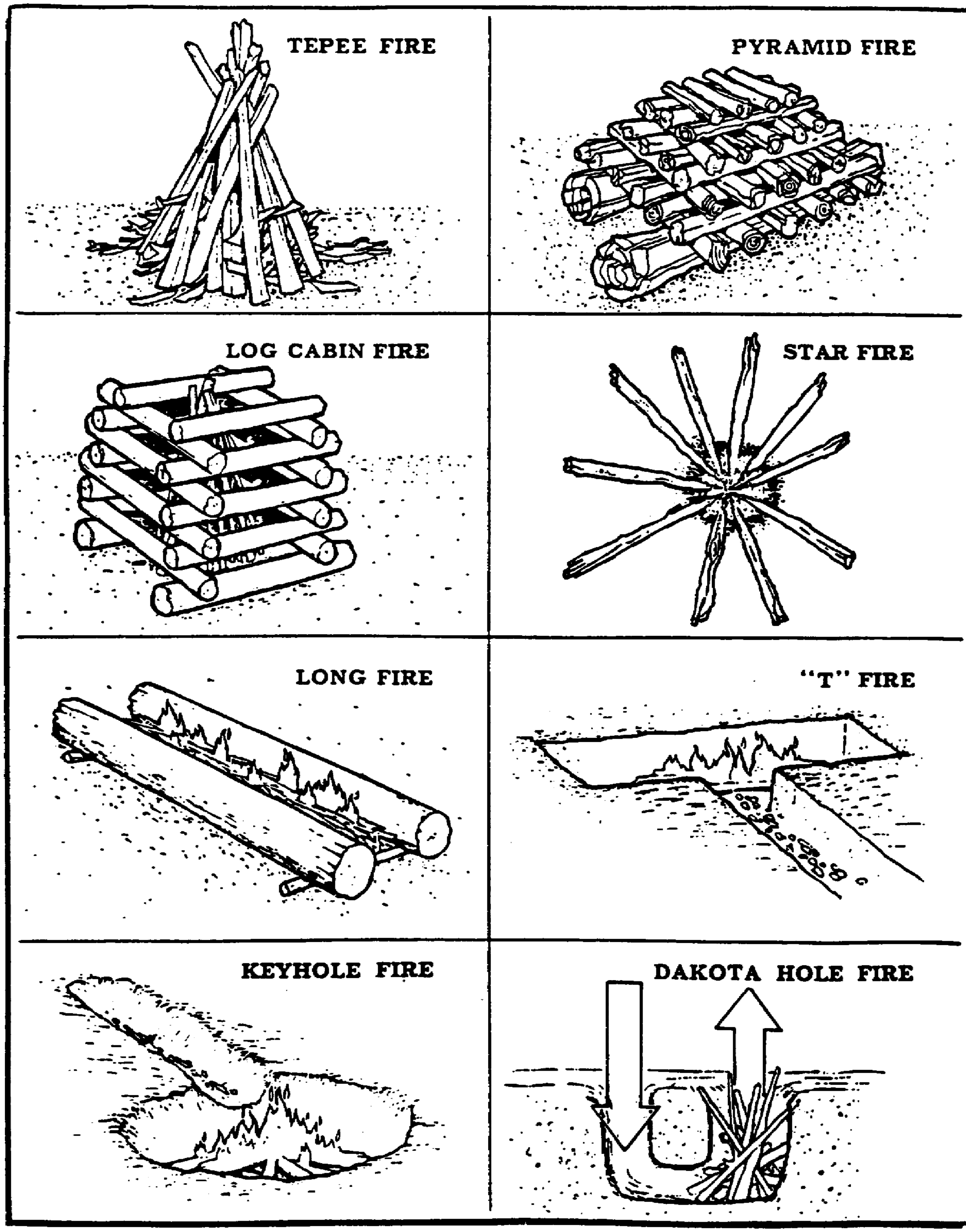

Figure 58. Fire lays.

(2) The "V" fire lay is a modification of the long fire. The configuration allows a survivor to either block strong winds or take advantage of light breezes. During high winds the vertex of the "V"-formed by the two outside logs--is placed in the direction from which the winds are coming, thereby sheltering the tinder (kindling) for ignition. Reversing the lay funnels light breezes into the tinder (kindling) to facilitate the ease of ignition (Figure 43).

d. Keyhole fire. To construct a keyhole fire, dig a hole in the shape of an old style keyhole. This type lay accomplishes the same thing as the long fire.

e. Pyramid Fire. The pyramid fire looks similar to a log cabin fire except there are layers of fuel in place of the hollow framework. The advantage of a pyramid fire is that it burns for a long time and results in a large bed of coals. This fire could possibly be used as an overnight fire when placed in front of a shelter opening.

f. Star Fire. Use the star fire when it is necessary to conserve fuel or when a small fire is desired. It burns at the center of the "wheel" and must be constantly tended. Hardwood fuels work best with this type of fire.

g. "T" Fire. This type fire is used for large group cooking. The size of this lay may be adjusted to meet the group's cooking needs. Construct the fire in the top part of the "T," and maintain it as long as needed to provide hot coals for cooking in the bottom part of the "T" fire lay. The number of hot coals may be adjusted in the lower part of the "T" fire lay to regulate the cooking temperature.

20. USEFUL HINTS

a. The ignition source used to ignite the fire must be quick and easily operated by hand. Any number of devices work well--matches, candle, lighter, fire starter, metal matches, and such. Be sure to protect your hands during ignition with some covering, such as mittens.

b. Conserve matches by only using them on properly prepared fires. Never use them to light cigarettes or for starting unnecessary fires.

c. Carry some dry tinder in a waterproof container. Expose the tinder to the sun on dry days. Adding a little powdered charcoal improves it. Cotton cloth is good tinder, especially if scorched or charred. It works well with a burning glass or flint and steel.

d. Remember that firemaking can be a difficult job in an arctic environment. Preparing for a fire starts well before the match is lit. Not only is the availability of firemaking materials a major problem, you must protect the fire from the wind. In wooded areas, standing timber and brush usually make a good windbreak, but in open areas, you may have to construct some type of windbreak. A row of snow blocks, the shelter of a

ridge, or a pile of brush works as well. The windbreak must be high enough to shield the fire from the wind. It may also act as a heat reflector if it is of solid material.

e. Take care when selecting an area for fire building. If the area has a large accumulation of peat, humus material, or both, you need a platform to avoid igniting the material as it tends to smolder long after the flames are extinguished. A smoldering peat fire is almost impossible to put out and may burn for years. Remember, you also need a platform to prevent the fire from melting down through the deep snow and extinguishing it and if the ground is moist or swampy. Make the platform from metal, green logs, or any material that does not burn through very readily. In forested areas, clear the debris on the ground and the lichen mat down to mineral soil, if possible, to prevent the fire from spreading.

EXERCISE

REQUIREMENT: Solve the following by selecting the correct answers:

1. How does perspiration affect the insulation qualities of clothing?

A. has no affect

B. causes overheating
C. reduces the effects
D. increases the effects

2. Gaiters and the Hudson Bay duffel are examples of

A. sleeping gear.
B. foot protection.
C. cold weather insulation techniques.
D. field expedient tools used to make survival clothing.

3. When are insects most active?

A. at night
B. in the spring
C. at dawn and dusk
D. immediately after a rain shower

4. It is desirable to wear lighter colored clothing in hot weather because it

A. absorbs more sunlight.
B. is a better insulator.
C. reflects sunlight and helps the body keep cool.
D. produces an area of low humidity between the body and clothing.

5. When building a survival shelter, you should consider

A. avoiding using man-made items.
B. building a shelter that can be used until you are rescued.
C. dismantling the shelter before daylight to avoid enemy detection.
D. using as little energy as possible yet attaining maximum protection from the environment.

6. What is the optimum angle of roof pitch, in degrees, for shedding precipitation and providing adequate shelter room?

A. 20
B. 30
C. 40
D. 60

7. In which survival environment would you decide to construct a raised platform shelter?

A. cold climate
B. hot, dry climate
C. high altitude region
D. an area containing high ground moisture levels or standing water

8. In a desert environment, consider erecting a shelter

A. that allows you to escape the heat and sun's rays.
B. whose site is out of the wind and close to a water source.

C. with building materials that make the shelter as dark and air tight as possible.
D. with a tunnel into the lee side of the sand dune in order to reduce the sand blasting effects of the wind.

9. The most difficult shelter type to construct in barren snow covered areas is the

A. igloo.
B. snow cave.
C. molded dome.
D. fighter trench.

10. As a general rule, unless you can see your breath while occupying a snow shelter, it is

A. too warm.
B. too cold.
C. too small.
D. Just right.

11. While occupying shelters in extremely cold environments, you should store firearms and ammunition

A. in no special way.
B. outside the shelter.
C. from a hook inside the shelter.
D. as close to the body as possible.

12. Material which has a low flash point and is ignited with a minimum heat source is

A. fuel.
B. tinder.
C. kindling.
D. flint shavings.

13. Avoid building a fire on

A. green logs.
B. wet or porous rocks.
C. a flat smooth surface.
D. a 3-foot diameter area of bare soil.

14. The fire starting heat source that is most dependent on the time of day and direct sunlight is

A. fire thong.
B. burning glass.
C. flint and steel.
D. bamboo fire saw.

15. Only use matches to

A. light cigarettes.
B. light rescue flares.
C. light properly prepared fires.
D. find important items in the dark.

16. The type of survival fire that allows you to block strong winds or take advantage of light breezes is the

A. "V" fire.
B. "T" fire.
C. long fire.
D. keyhole fire.

REVIEW EXERCISE SOLUTIONS

1. C. (paragraph 3a(1))

2. B. (paragraph 7c and e)

3. C. (paragraph 4a(1))

4. C. (paragraph 4b(1))

5. D. (paragraph 8)

6. D. (paragraph 11d(1))

7. D. (paragraph 12a)

8. A. (paragraph 12b)

9. A. (paragraph 9d(2))

10. A. (paragraph 13c)

11. B. (paragraph 15a)

12. B. (paragraph 16a(1))

13. B. (paragraph 18a NOTE)

14. B. (paragraph 16b(4))

15. C. (paragraph 20b)

16. A. (paragraph 19c(2))